ENERGY TRANSITION IN TIMES OF CRISES

GERMAN COUNCIL
of Economic Experts

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German Council of Economic Experts (GCEE)

ECA Expert Forum, Berlin – April 17, 2023

ENERGY CRISIS AND TRANSFORMATION CHALLENGES

ENERGY CRISIS

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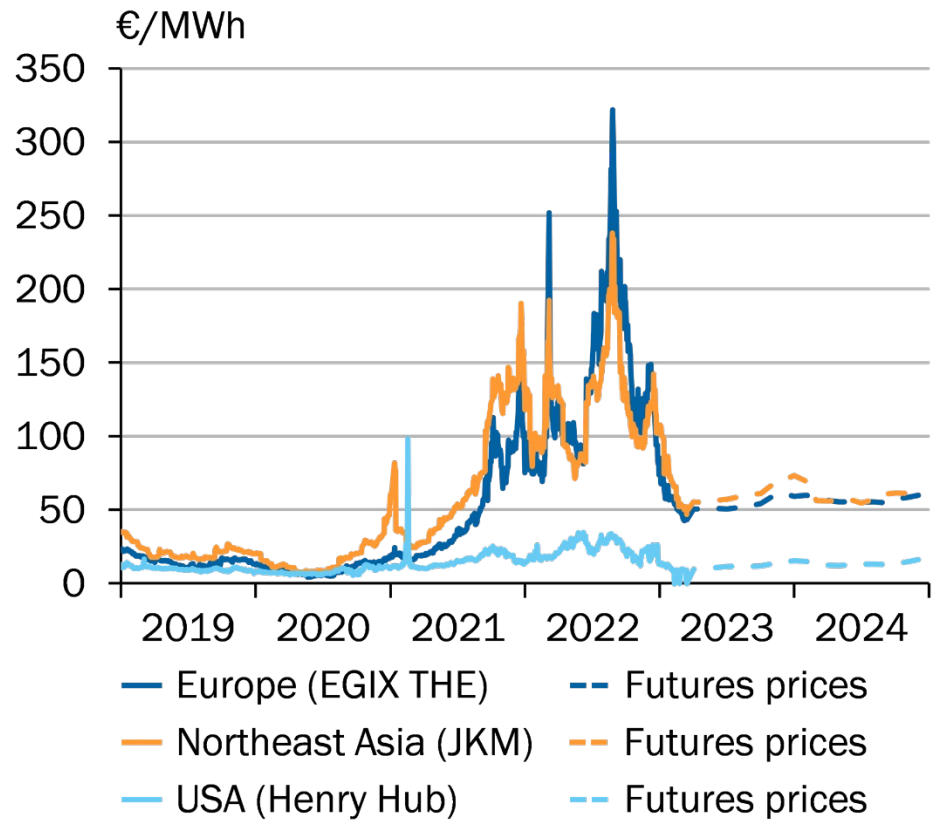
Historically high gas and electricity prices – avoiding gas shortage & cushioning the burden

Price increases particularly high for gas



Sources: EEX, EIA, ICE, NYMEX, Refinitiv Datastream, own calculations
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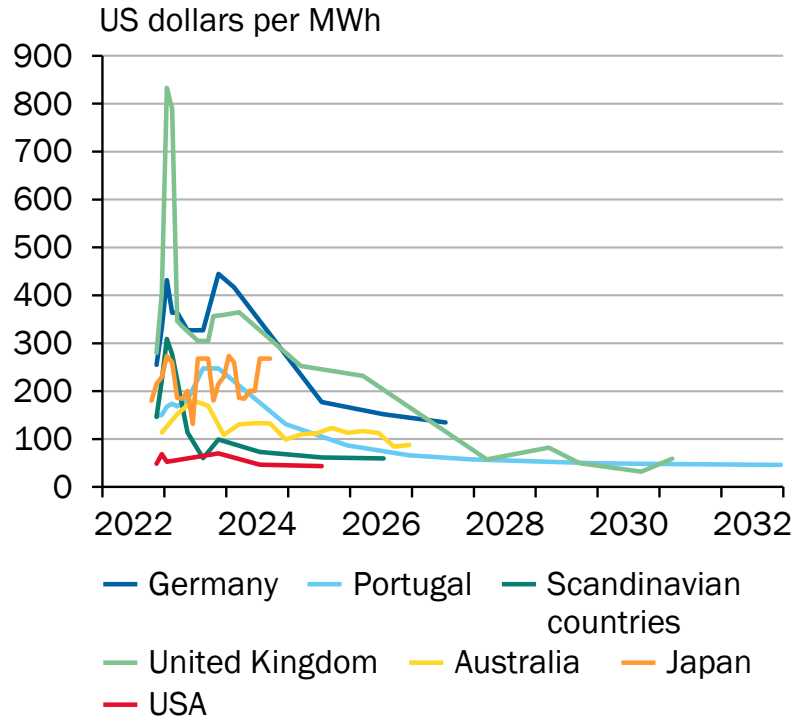
Fast expansion of renewables is an important building block for limitting energy price increases in the medium term



PROPOSED INTERVENTIONS IN THE (ELECTRICITY) MARKET DESIGN (SELECTION)

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- Multiple proposals

1) Price caps for gas used for electricity production
2) Different markets for technologies with high and low marginal costs
3) Tax on windfall profits
4) Price cap for gas & electricity

Consequences of the proposals are manifold:

Grimm/Ockenfels/Zöttl (2008)
Hirth/Maurer/Schlecht (2022)
Eicke/Hirth/Maurer/Mühlenpfordt/Schlecht (2022)
Ockenfels (2022)

- Interventions in the electricity market design likely worsen the situation
- **Price caps** increase the incentive to consume electricity or gas
- **Separation of the markets** for technologies with high and low marginal costs not possible without severe interventions (reason: trade beyond the power exchange, long term contracts, imports/exports)
- If measures have to be taken, then **taxation of inframarginal technologies** least harmful – but revenues might be low
- *Tax the revenue from inframarginal electricity production whenever gas-fired power plants are marginal*

PROPOSAL OF THE GERMAN EXPERT COMISSION ON GAS AND HEAT

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Increase gas supply and **reduce demand**:

- Joint gas procurement in Europe
- increase electricity generation capacities in Germany in the short term
- reduce the need for gas-fired power generation.
- expansion of renewable energies
- gas savings of at least 20 percent by better informing consumers and by financial bonuses (savings premiums).
- transformative steps that save gas in the short term

„GAS PRICE BRAKE“:

Household and small businesses:

- the state is to take over the entire payment in December.
- from March 2023: cost is reduced to 12 ct/kWh for 80% of historial consumption level or equivalent (no reduction to pre-crisis levels).

Big industrial customers:

- „Gas price brake“ from 1st Jan. Cost of 70% of past consumption is reduced to 7ct/kWh (excluding network fees, subsidies subject to state aid law), opt in, Conditional on site perservation.

Special fund for hardship cases

NECESSARY GAS SAVINGS IN THE EU

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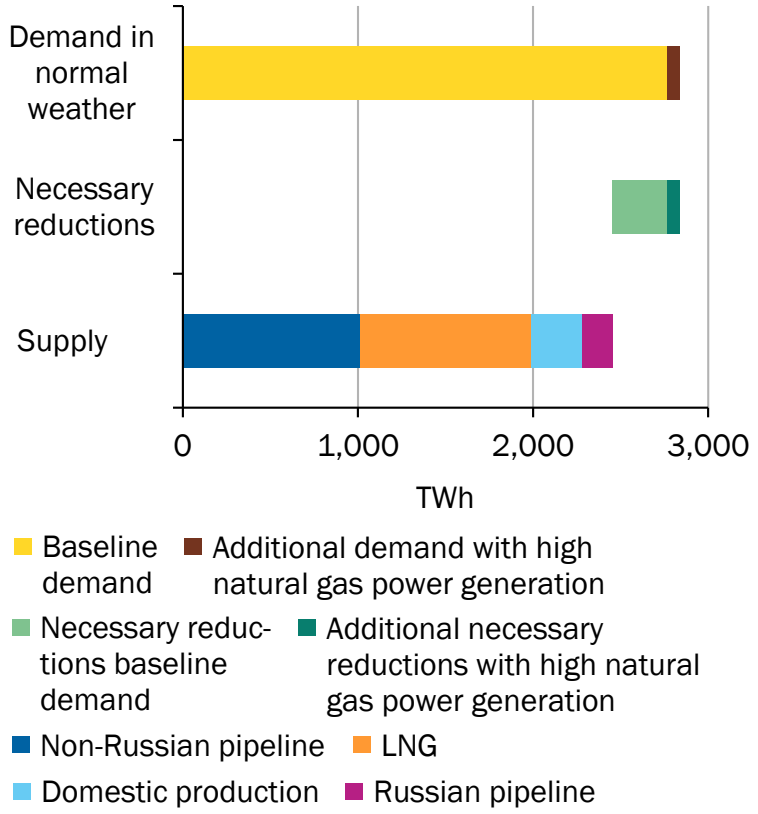
Uncertainty about future energy supply remains high – gas savings are crucial

Estimated gas balance in the EU from 1. February until 30. September 2023 (McWilliams et al., 2023)



Sources: Aggregated Gas Storage Inventory (AGSI), McWilliams et al. (2023)
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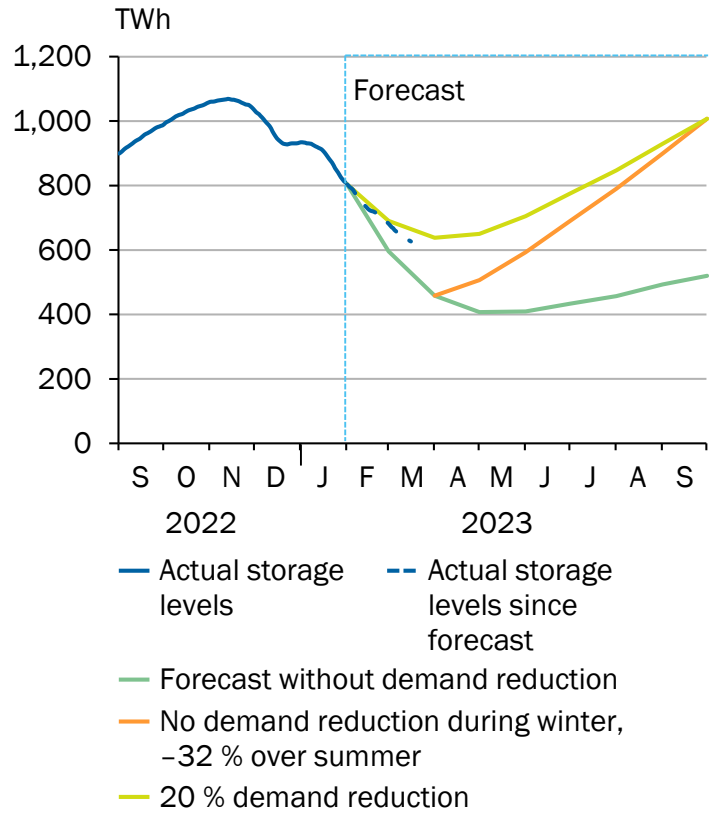
Gas storage levels in the EU (McWilliams et al., 2023)



Sources: Aggregated Gas Storage Inventory (AGSI), McWilliams et al. (2023)
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PRICE-DRIVEN GAS SAVINGS

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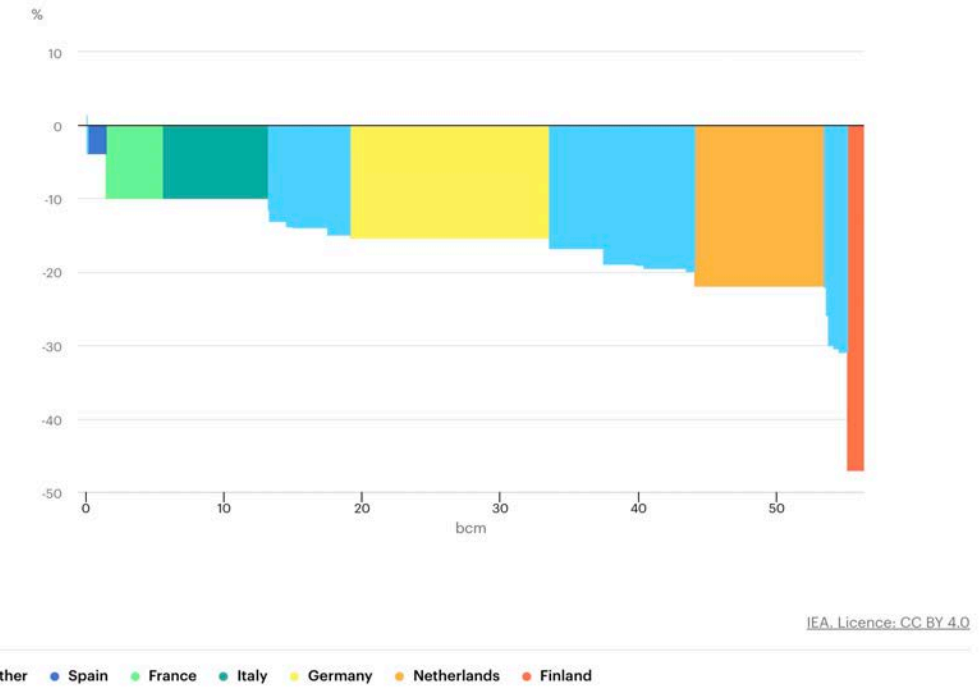
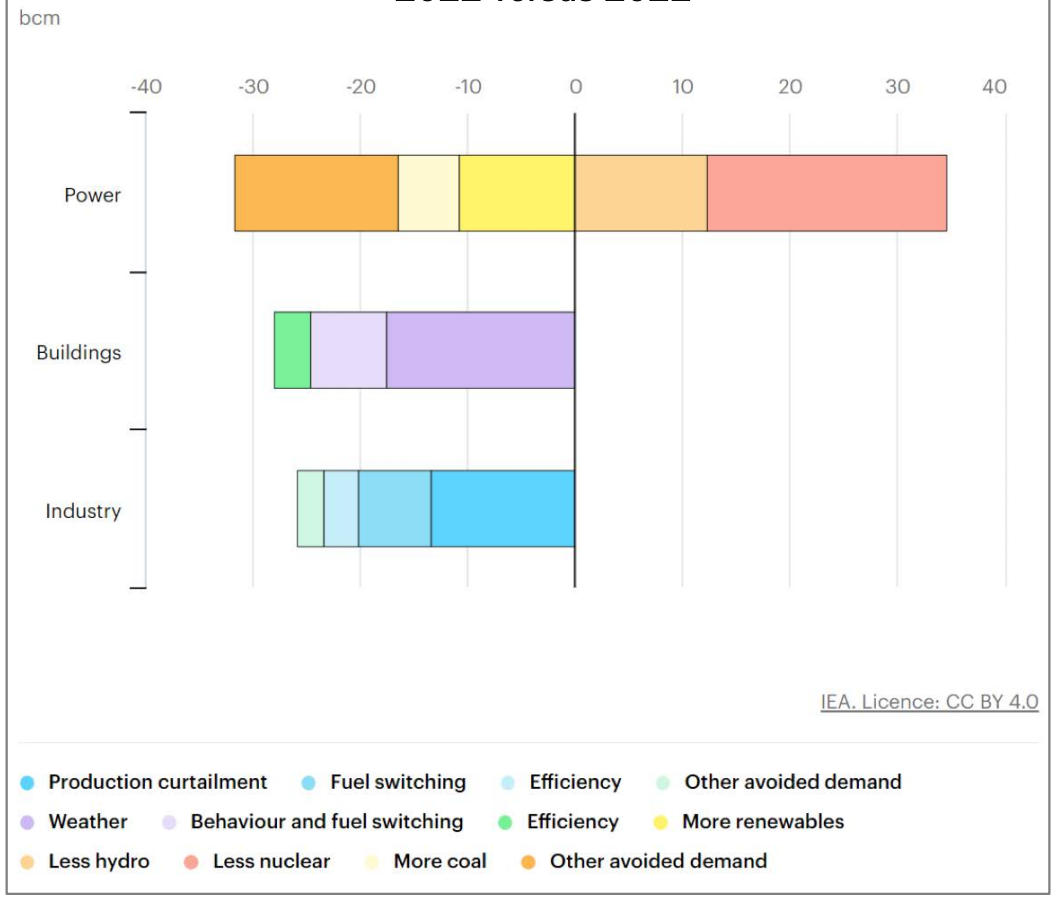
Industrial customers, commercial customers and households contribute to gas savings

Change in natural gas demand by European Union member state, 2022 vs 2021



Estimated drivers of change in natural gas demand in power, buildings and industry in the European Union, 2022 versus 2021



Source: IEA at https://www.iea.org/commentaries/europe-s-energy-crisis-what-factors-drove-the-record-fall-in-natural-gas-demand-in-2022

EXPANSION OF ENERGY SUPPLY

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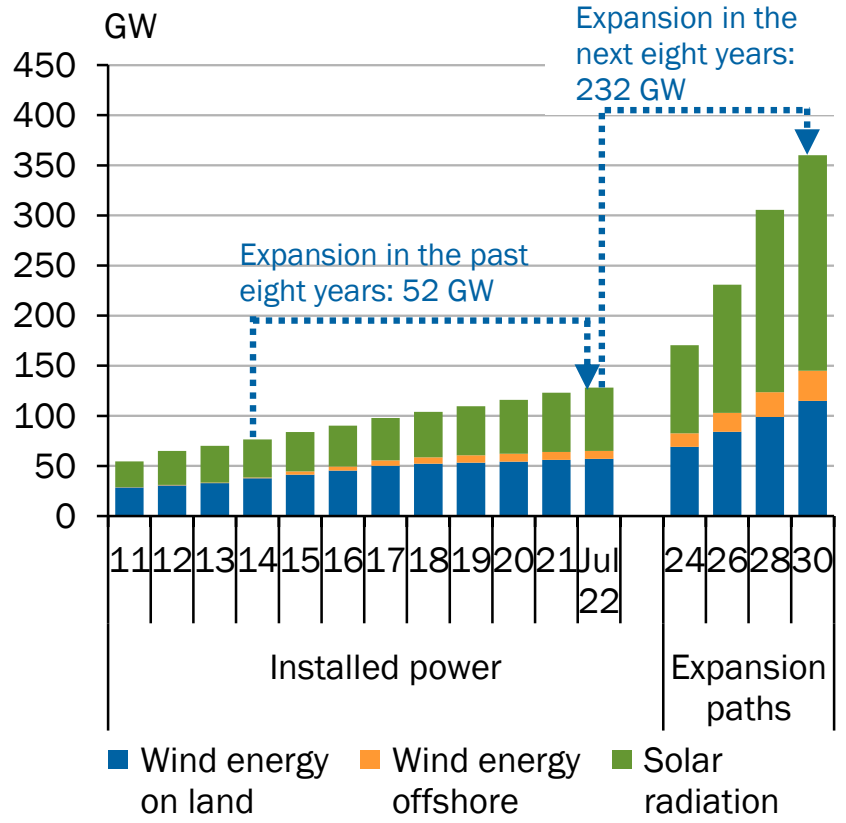
Expansion of renewables and substitution away from Russian gas.

Accelerated expansion of renewables requires extension of eligible areas for renewables and accelerated permitting



Sources: Bundesnetzagentur, Federal Government, own calculations
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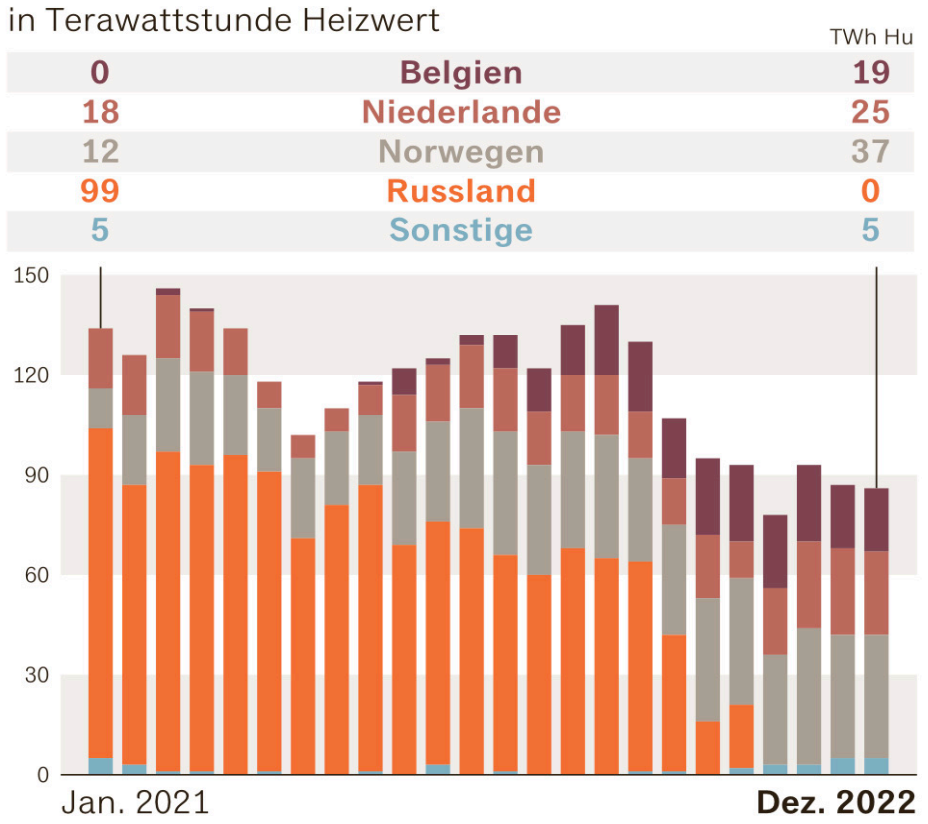
Origin of German gas imports (in TWh)

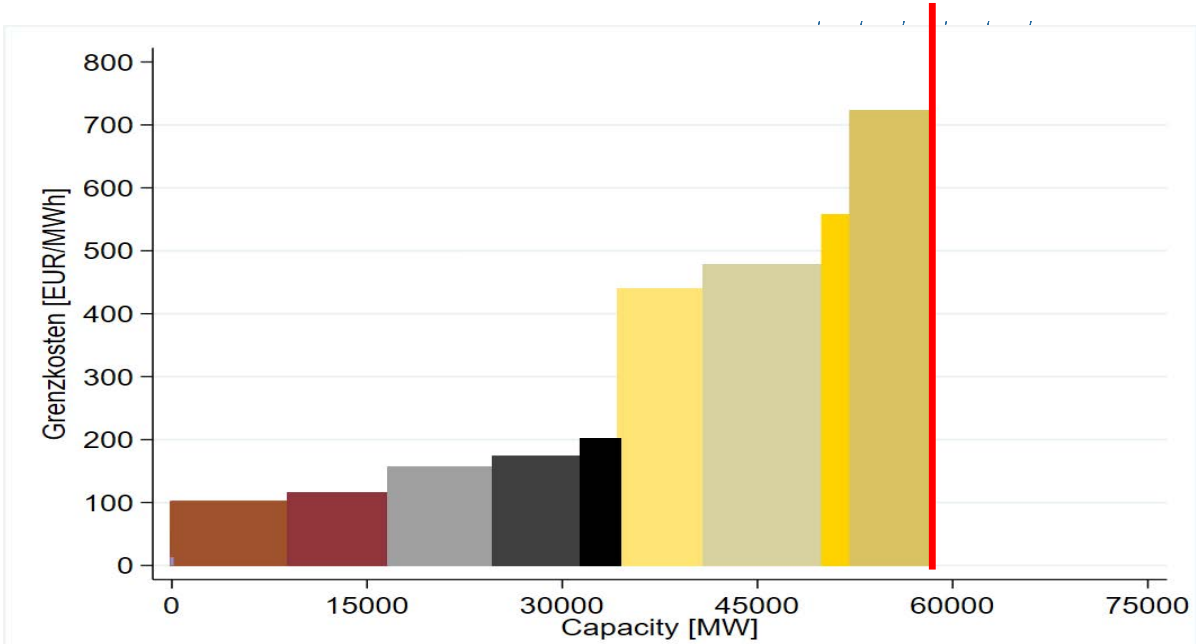


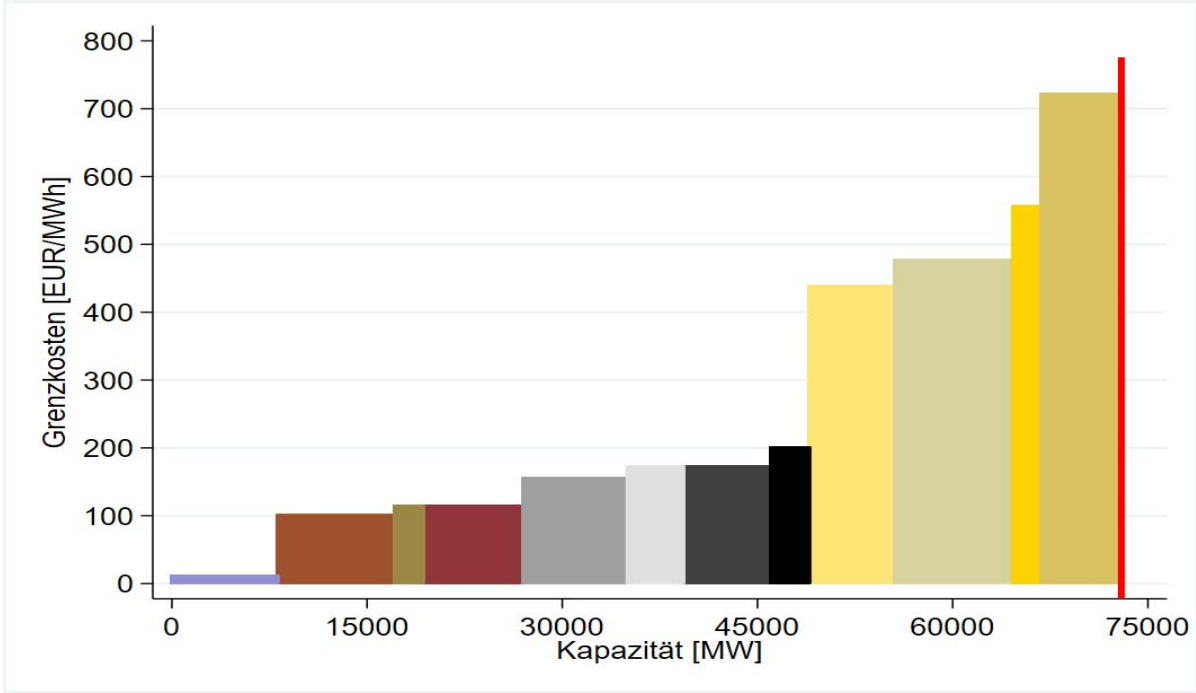
HANDELSBLATT

Quellen: Prognos, Entsog, Eurostat

URGENT: ACTIVATION OF AVAILABLE CAPACITY

- Shift the merit order outwards instead of abolishing it
  - Re-activate nuclear & coal
- Mobilize capacity available in the short term
- Increase incentives to build gas power plants
- Make hydrogen available (long term contracts, network expansion)





EXPANSION OF H2-READY POWER PLANTS

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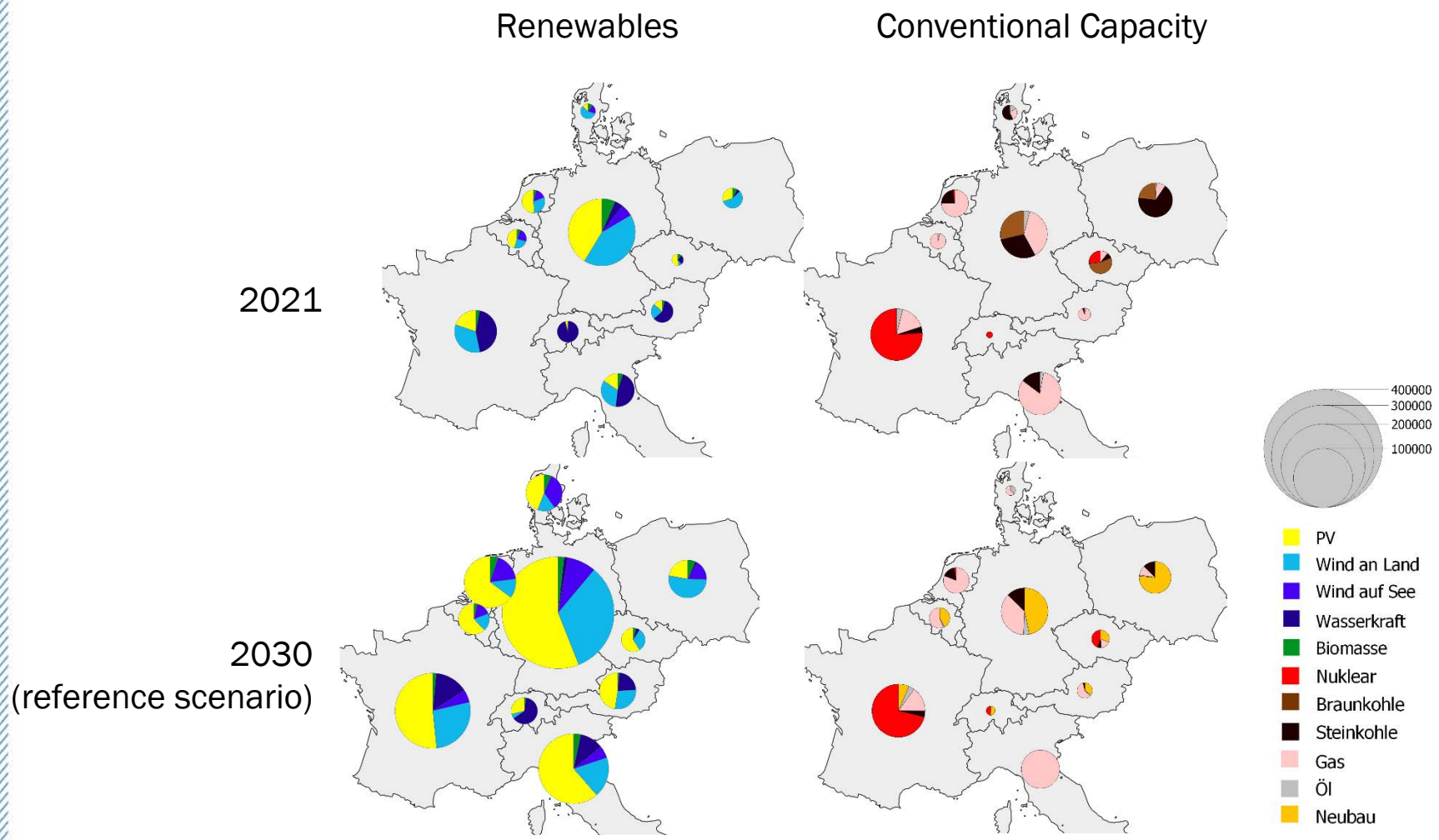
20-30 GW generation capacity and climate friendly hydrogen are needed until 2030



Previous expectation (until 2021):

If RE had been added on the basis of national expansion plans, coal-fired power plants would have been almost completely replaced by gas-fired power plants.

(Lignite completely dismantled, hard coal with low full load hours).

Egerer, J., V. Grimm, L. M. Lang, U. Pfefferer. **Kohleausstieg unter neuen Vorzeichen - Kurzstudie.** Wirtschaftsdienst

SOCIAL BALANCE IS A SUCCESS CONDITION

CUSHIONING THE BURDEN FOR HOUSEHOLDS AND FIRMS

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Particularly gas customers faced high uncertainty and a potentially high additional cost burden

Particularly high burden for gas customers (here: households)

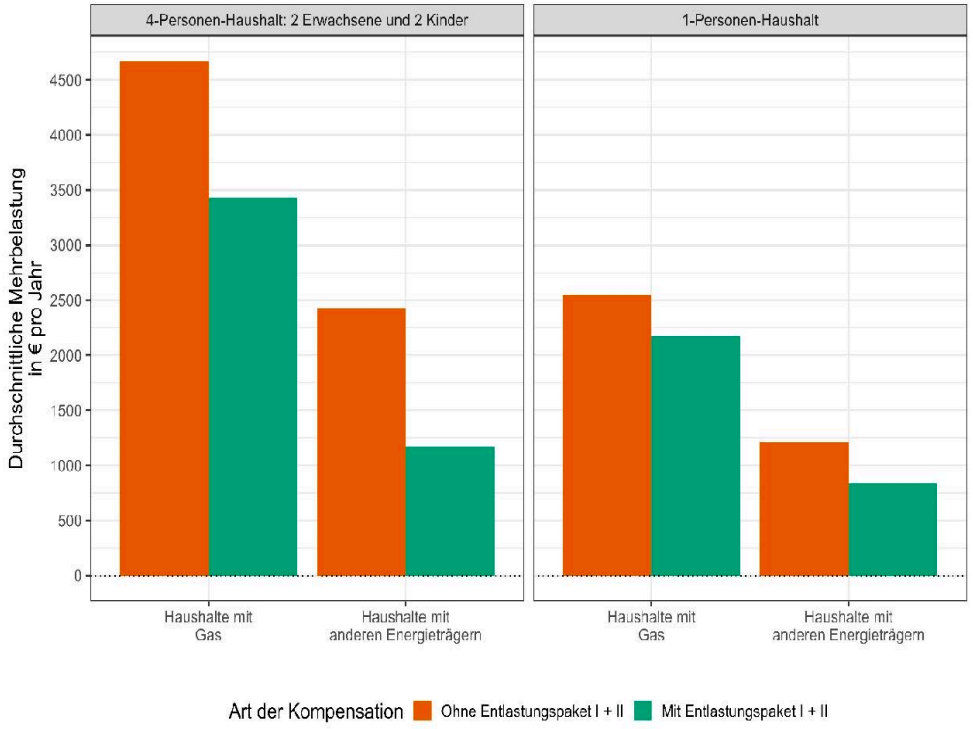
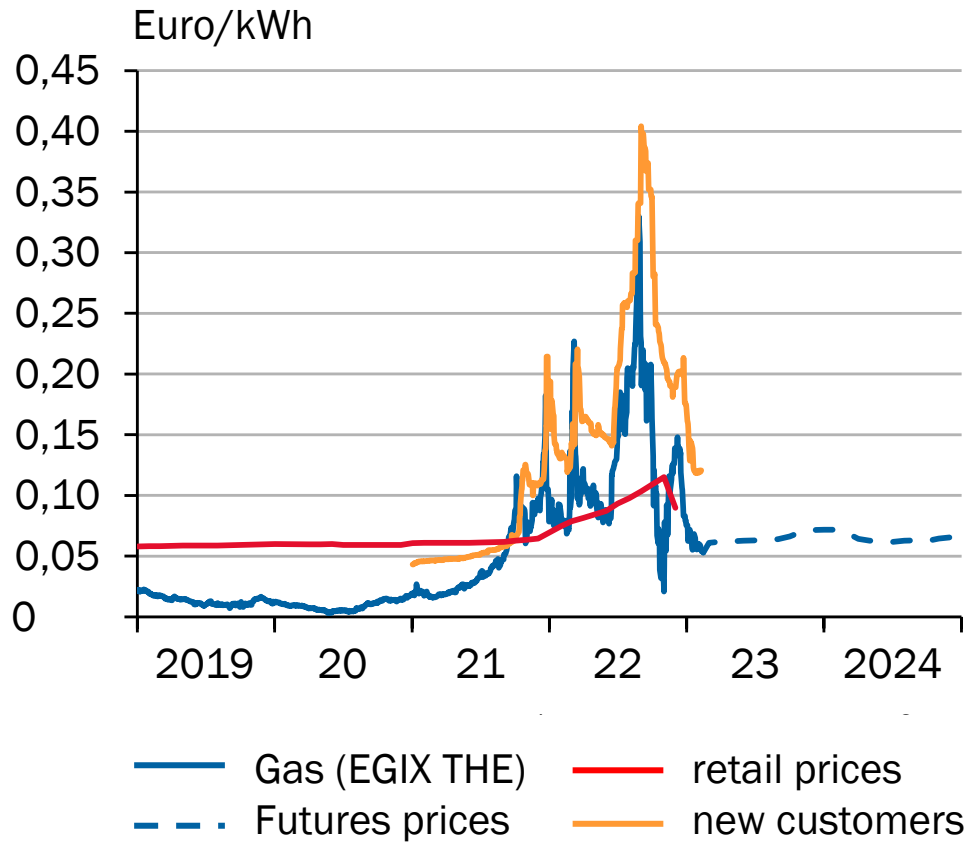


Abbildung Z 1: Mehrbelastung durch aktuelle Energiepreise für Haushalte für den Zeitraum Mai 2022 bis April 2023 (relativ zum langfristigen Energiepreisniveau 2017-2021). Eigene Berechnungen basierend auf EVS 2018.

Gas prices reached consumers with a delay



Source: MCC at https://www.mcc-berlin.net/fileadmin/data/C18_MCC_Publications/2022_MCC_Gaspreise_und_Entlastungsmaßnahmen.pdf

THE GERMAN GAS PRICE BRAKE

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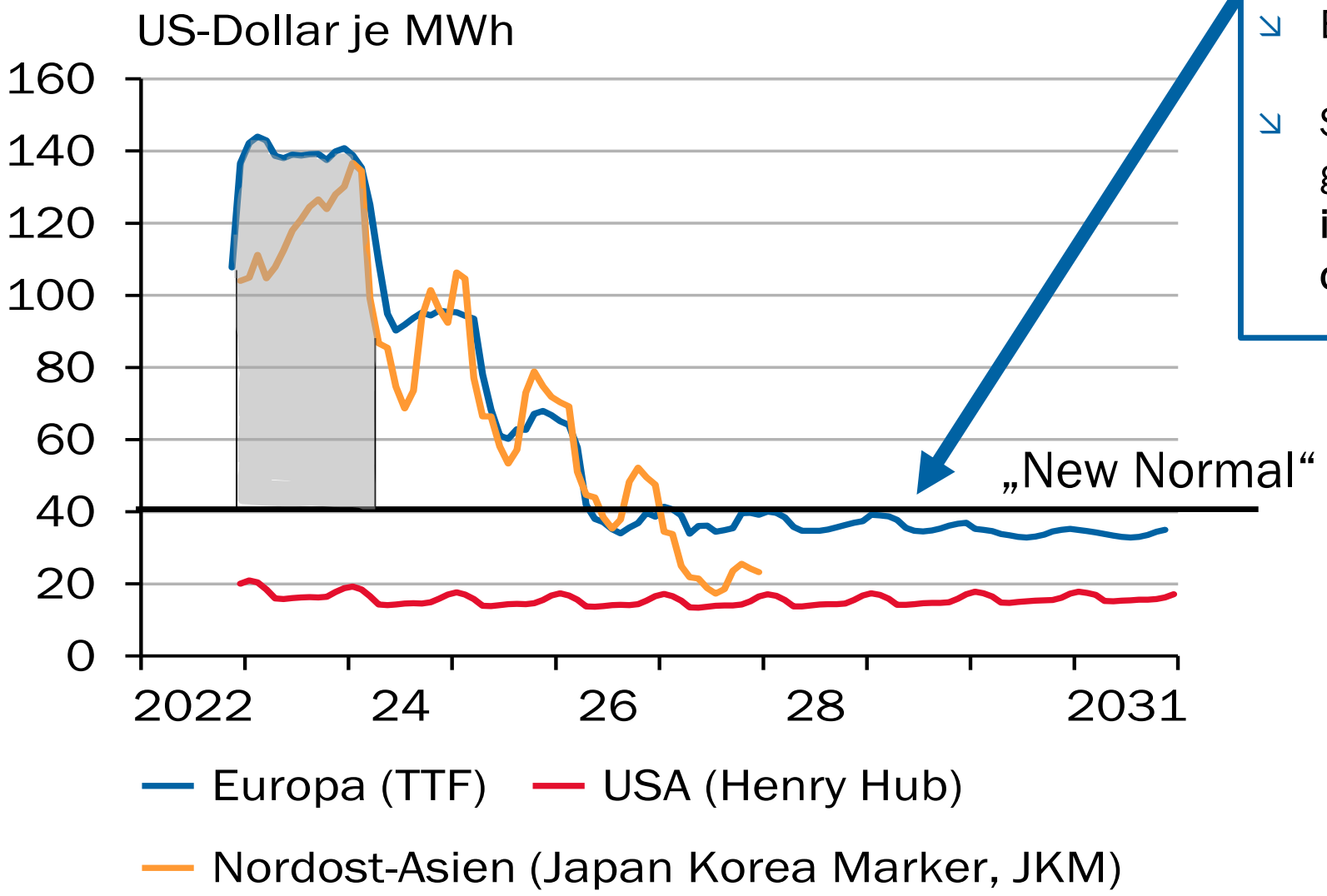

- Establish the **„New Normal“**
- Subsidies depend on past gas consumption but are **independent of actual gas consumption**

Bayaz, D., Grimm, V. (FAS, 03.09.2022) Das ist unser Deutschlandtarif.

ExpertInnen-Kommission Gas und Wärme (2022), Sicher durch den Winter – Abschlussbericht, 31.10.2022, Berlin.

INCREASE ENERGY SUPPLY & REDUCE DEMAND

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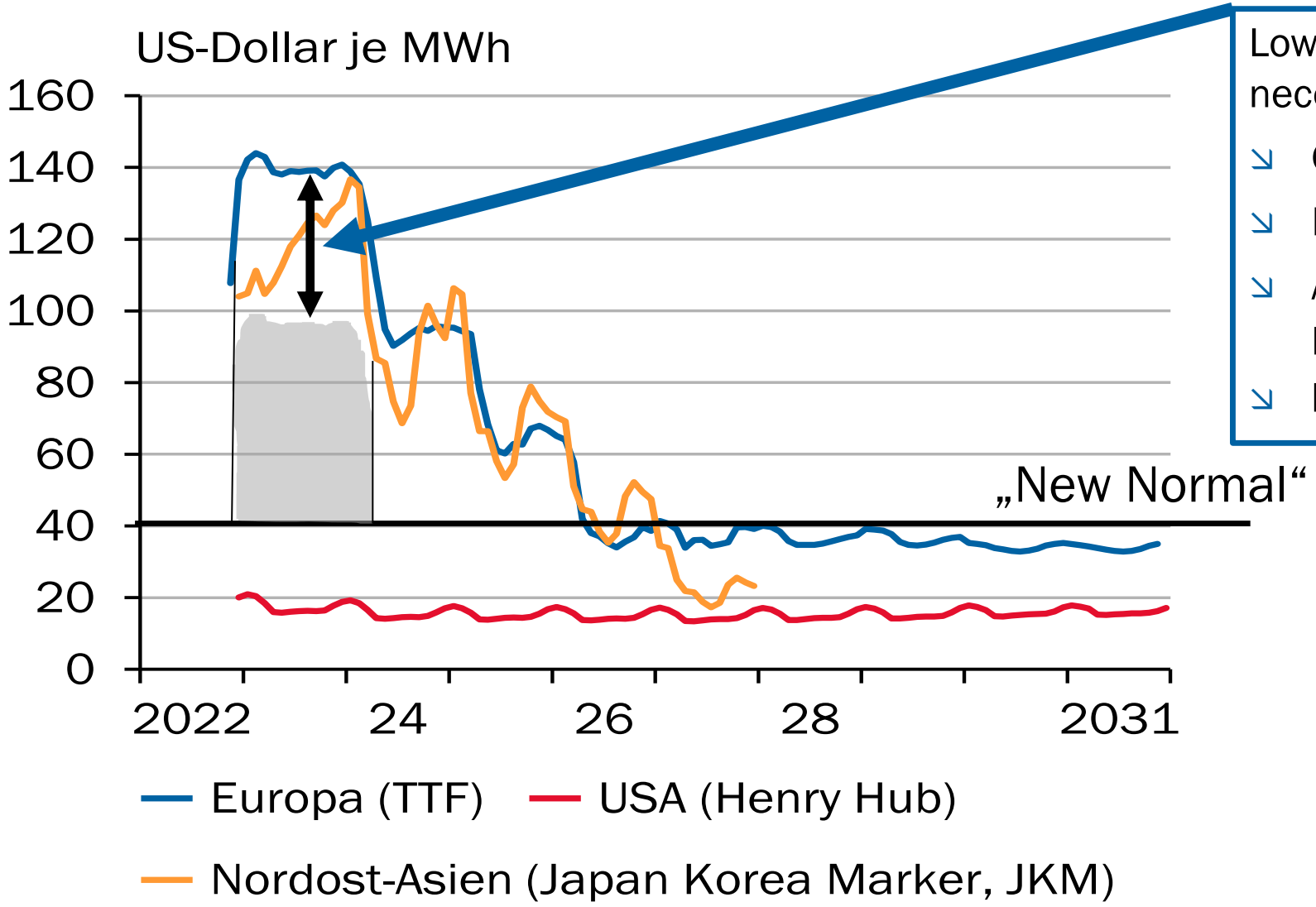

Lower gas prices reduce necessary subsidies:

- ↘ Gas procurement
- ↘ RES expansion
- ↘ Activate nuclear, coal plants
- ↘ **Energy efficiency**

EMISSION TRADING & CLIMATE MONEY GUARANTEES TARGET ACHIEVEMENT & ACCEPTANCE

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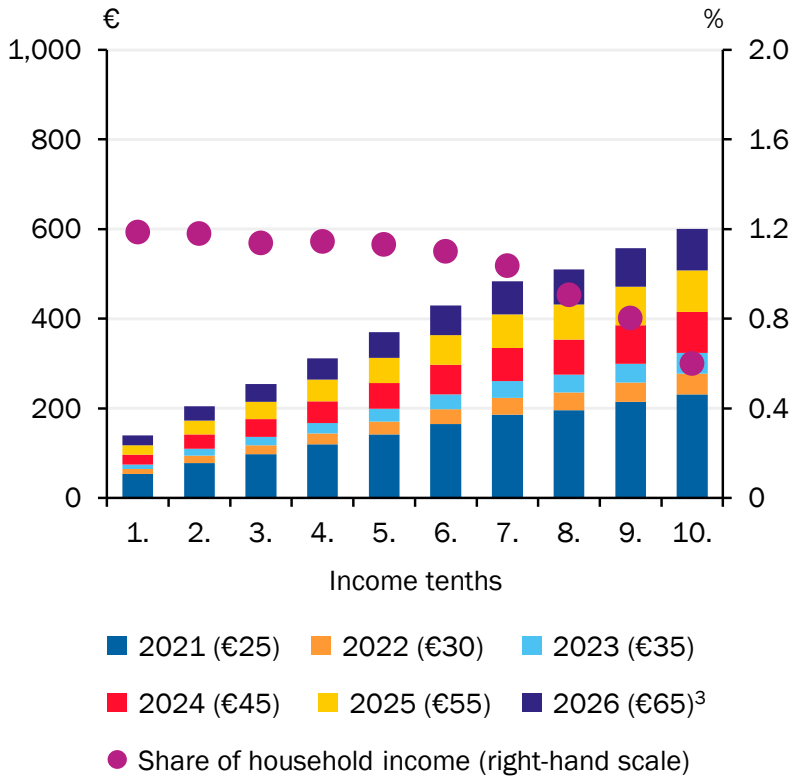
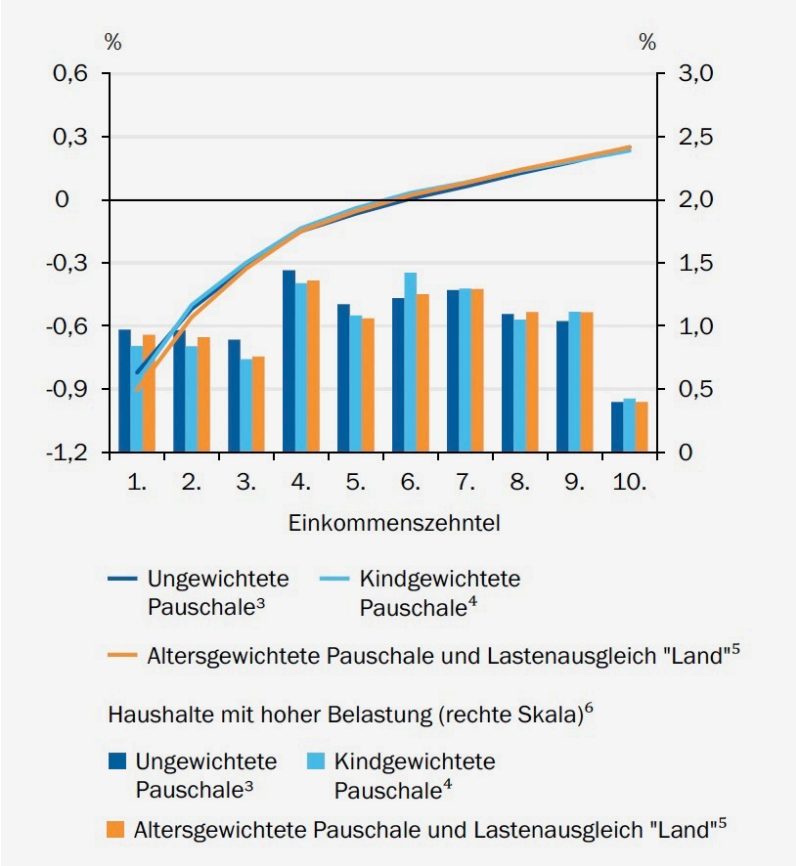
Absolute and relative financial burden imposed on households by carbon pricing per tonne[1]
by income tenths[2]



Redistribution per capita – average relative burden for income deciles



Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2020), Jahresgutachten 2020/21, Kapitel 4.


INDUSTRY
TRANSFORMATION
IS ACCELERATED

ACCELERATE THE DEFOSSILISATION OF INDUSTRY

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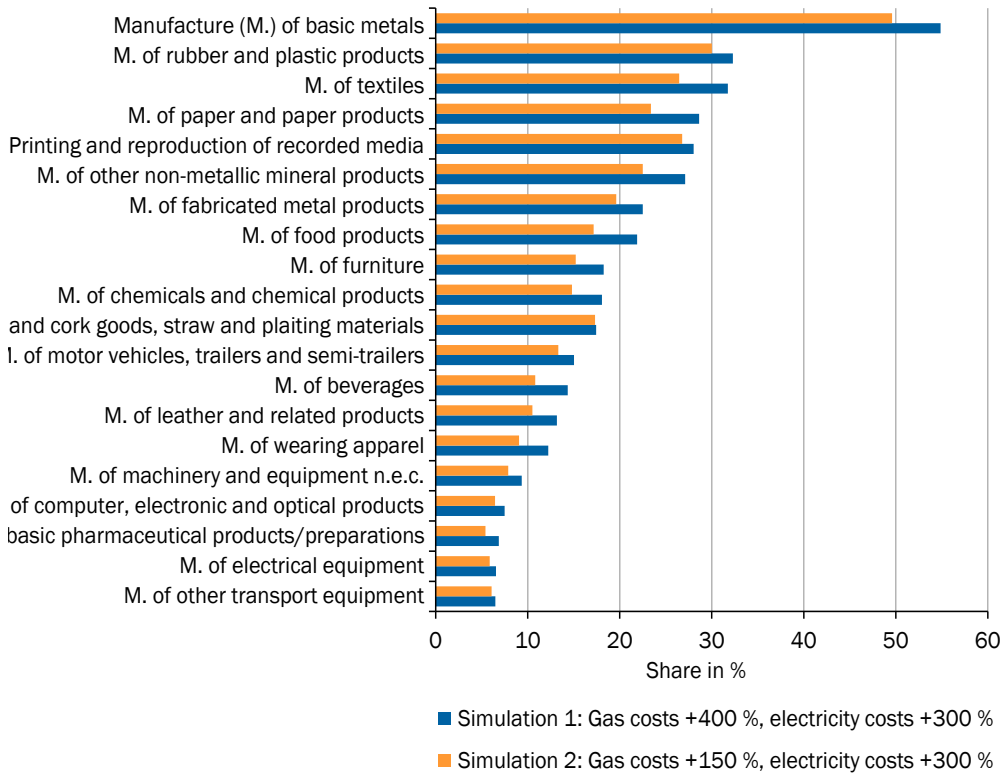
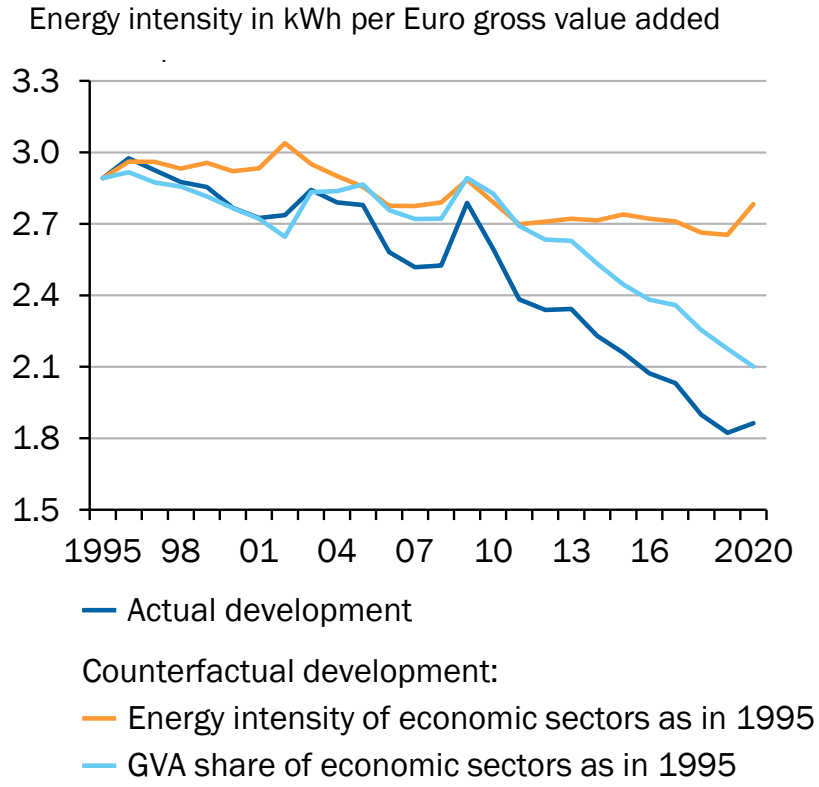
Increase energy efficiency, substitute fossil fuels by electrification and hydrogen

Share of companies with negative gross margin due to a simulated cost exchange



Sources: RDC of the Federal Statistical Office and Statistical Offices of the Länder, AFiD-Panel Industrieunternehmen 2001–2018 and AFiD-Modul Energieverwendung 2005–2018, own calculations
© Sachverständigenrat | 22-403-02

Structural change and (most of all) efficieny gains within industries have contributed to the decline in energy intensity



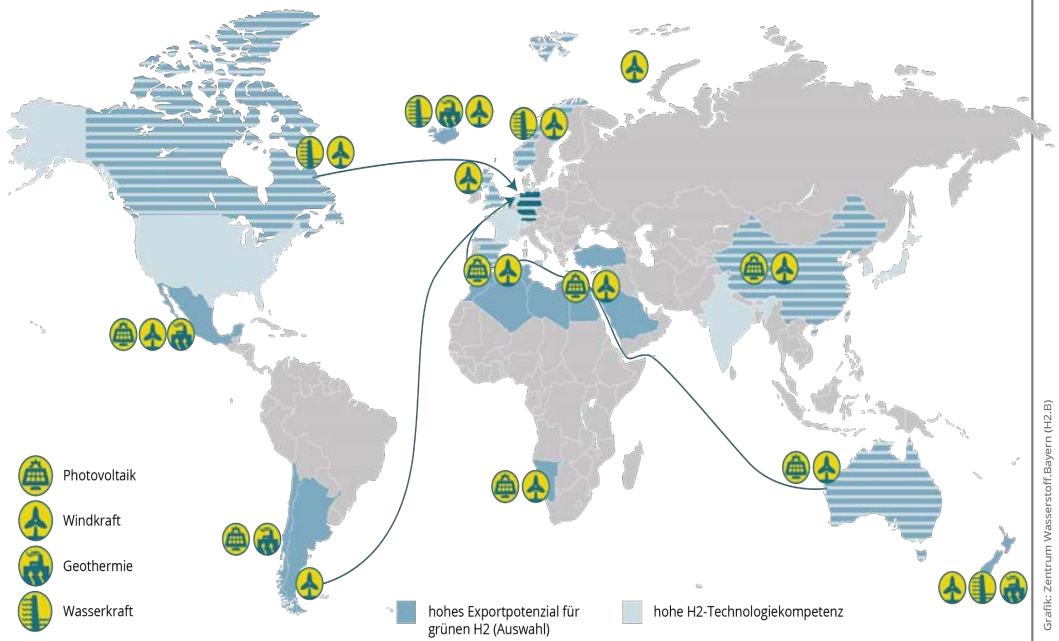
Sources: Federal Statistical Office, own calculations
© Sachverständigenrat | 22-194-04

ACCELERATE H2-IMPORTS, EXPAND H2-NETWORKS

Runge, P, C. Sölch, J. Albert, Jakob, P. Wasserscheid,, G. Zöttl, V. Grimm, **Economic Comparison of Electric Fuels Produced at Excellent Locations for Renewable Energies: A Scenario for 2035**

Combine LNG and H2 procurement, act at european level, build H2 networks

Wasserstoffimporte anstossen



Sources: Bundesnetzagentur, Federal Government, own calculations
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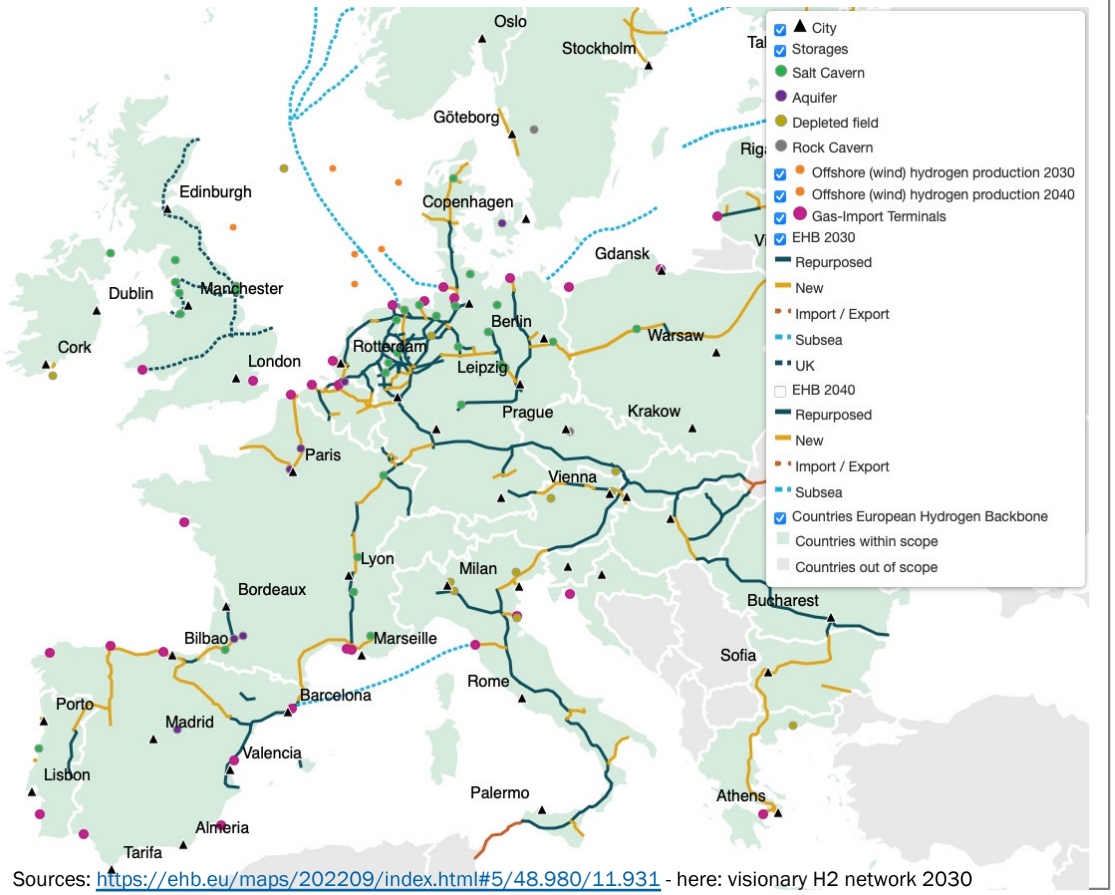
H2-Netzausbau europäisch vorantreiben



Sources: https://ehb.eu/maps/202209/index.html#5/48.980/11.931 - here: visionary H2 network 2030

PROJECTED HYDROGEN DEMAND

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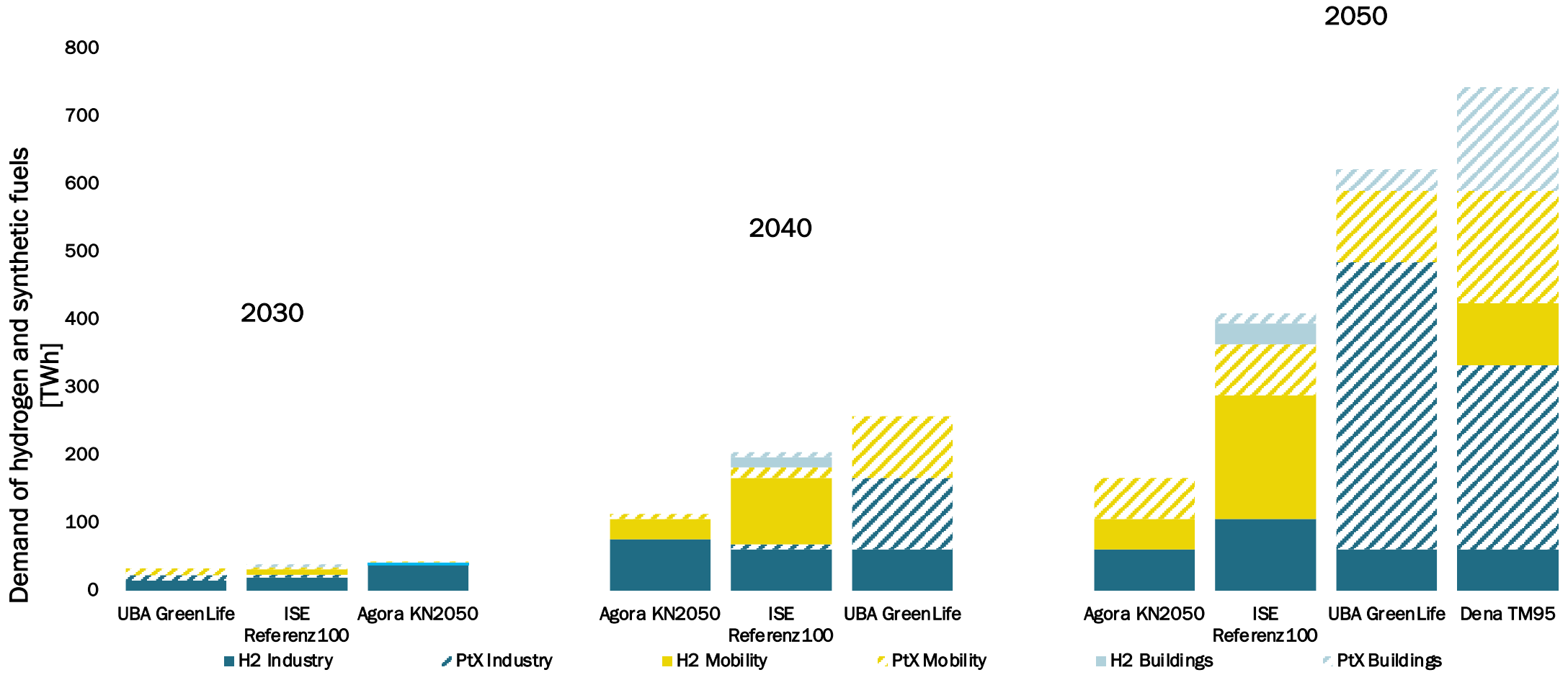
PROJECTED DEMAND FOR HYDROGEN AND SYNTHETIC ENERGY CARRIERS IN GERMANY (METASTUDY FOR THE GERMAN HYDROGEN COUNCIL BY FHG, 2021)



Source: German H2 Council at https://www.wasserstoffrat.de/fileadmin/wasserstoffrat/media/Dokumente/Metastudie_Wasserstoff-Abschlussbericht.pdf

SECTOR COUPLING IS THE KEY

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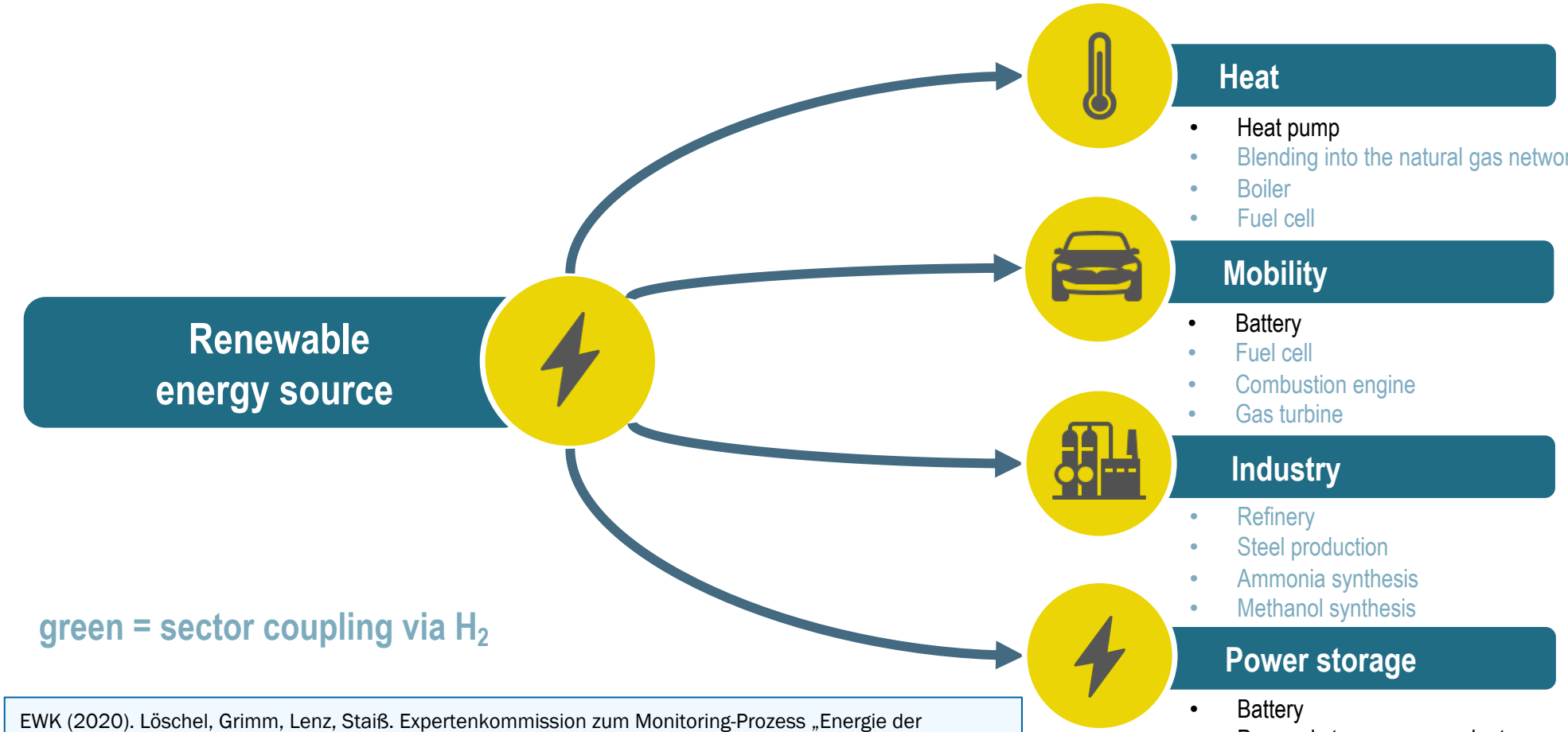

green = sector coupling via H_2

EWK (2020). Löschel, Grimm, Lenz, Staiß. Expertenkommission zum Monitoring-Prozess „Energie der Zukunft“: Klimaschutz vorantreiben, Wohlstand stärken – Kommentierung zentraler Handlungsfelder der deutschen Energiewende im europäischen Kontext.

EWK (2021). Löschel, Grimm, Lenz, Staiß. Expertenkommission zum Monitoring-Prozess „Energie der Zukunft“: Stellungnahme zum 8. Monitoringbericht der Bundesregierung für die Berichtsjahre 2018 und 2019.

ASSESSMENT OF INDUSTRIAL H2 DEMAND IN GERMANY WITHOUT RELOCATION OF PRODUCTION

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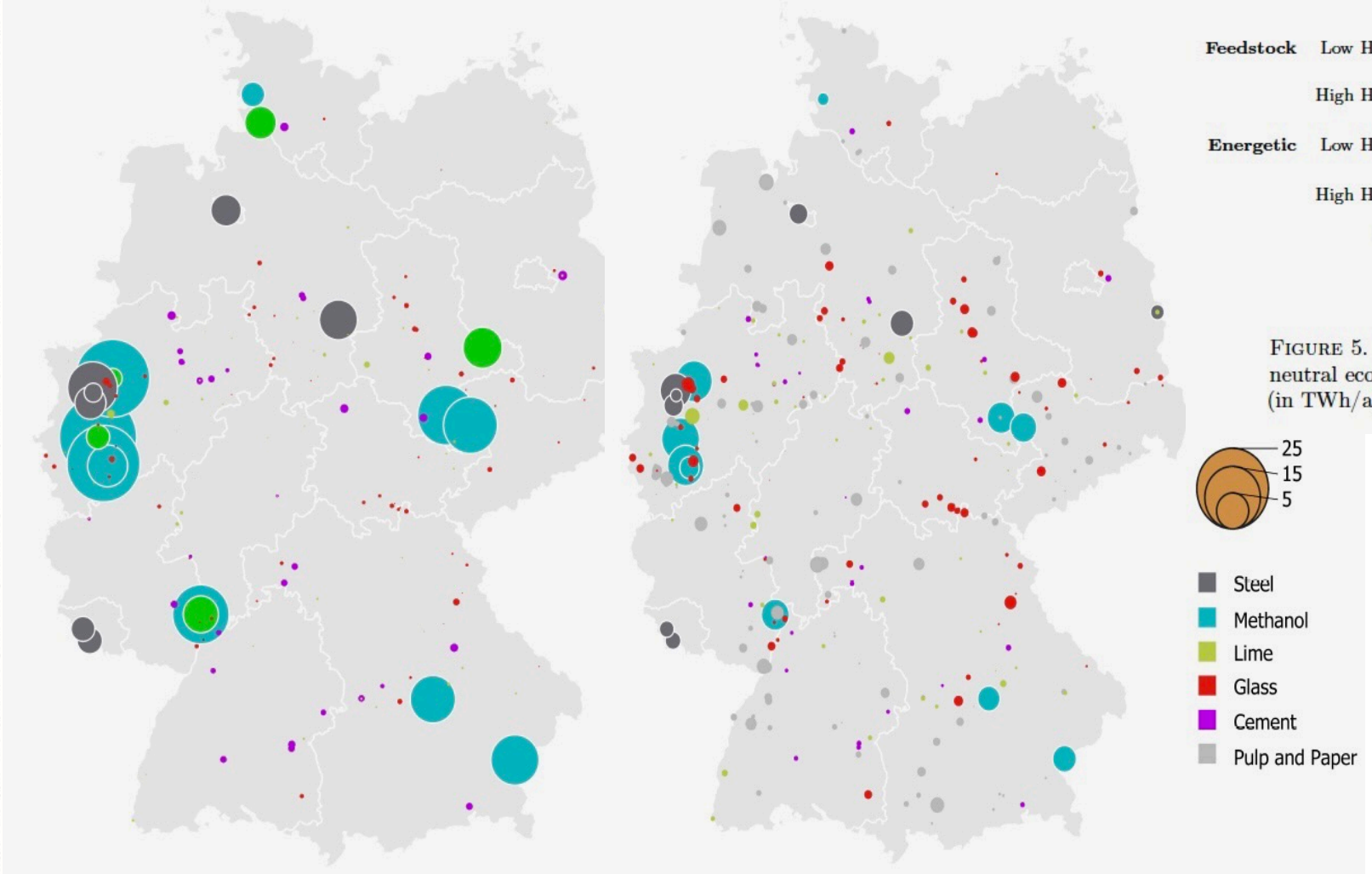


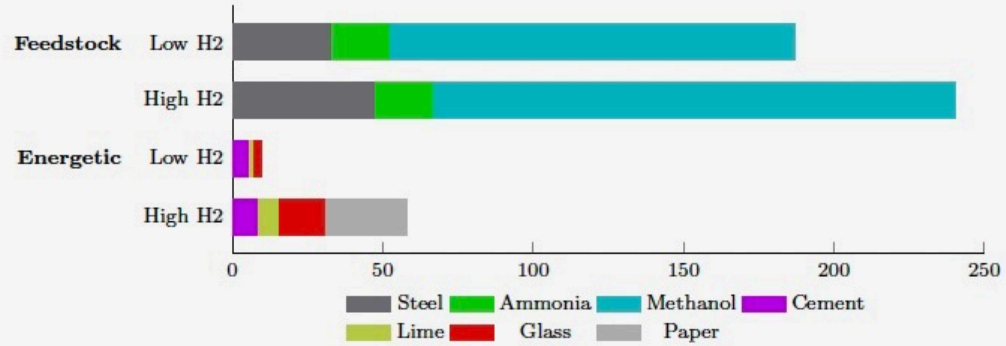


FIGURE 5. Projected industrial hydrogen demand for Germany in a carbon-neutral economy without relocation of energy intensive production abroad (in TWh/a)

Egerer, J., V. Grimm, N. Farhang-Damghani und P. Runge (2023b), **The Industry Transformation from Fossil Fuels to Hydrogen will reorganize Value Chains: Big Picture and Case Studies for Germany,**

Lower bound scenario

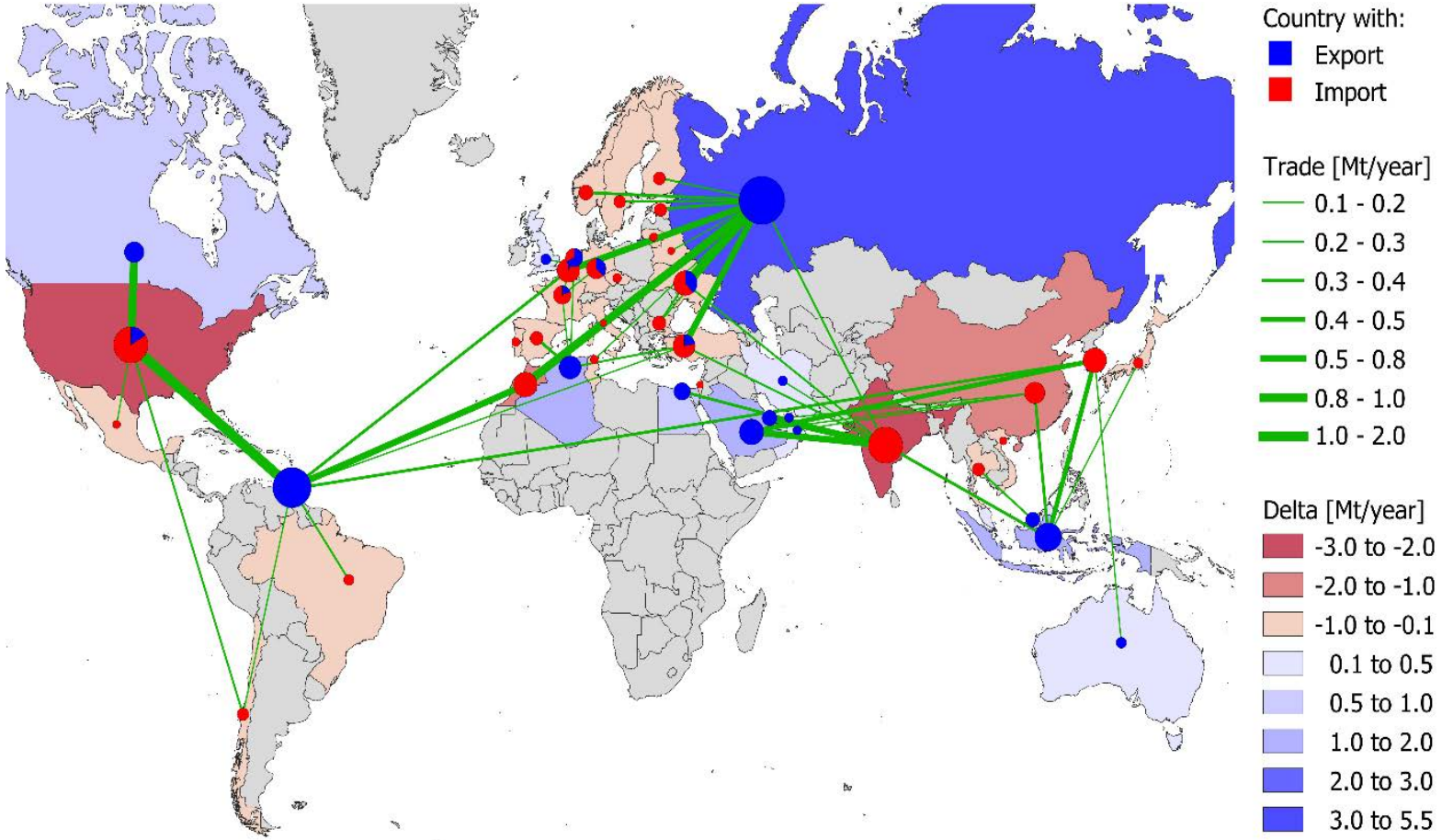
Δ between higher and lower H2 demand scenarios

GLOBAL AMMONIA TRADE FLOWS

Ammonia is the first available option to trade H2 at a large scale

Egerer, J., V. Grimm, K. Niazmand und P. Runge (2023a), **The economics of global green ammonia trade – "Shipping Australian wind and sunshine to Germany"** Applied Energy, 334 (2023), 120661

Figure: Global ammonia trade flows and balances larger 0.1 Mt per year in 2019

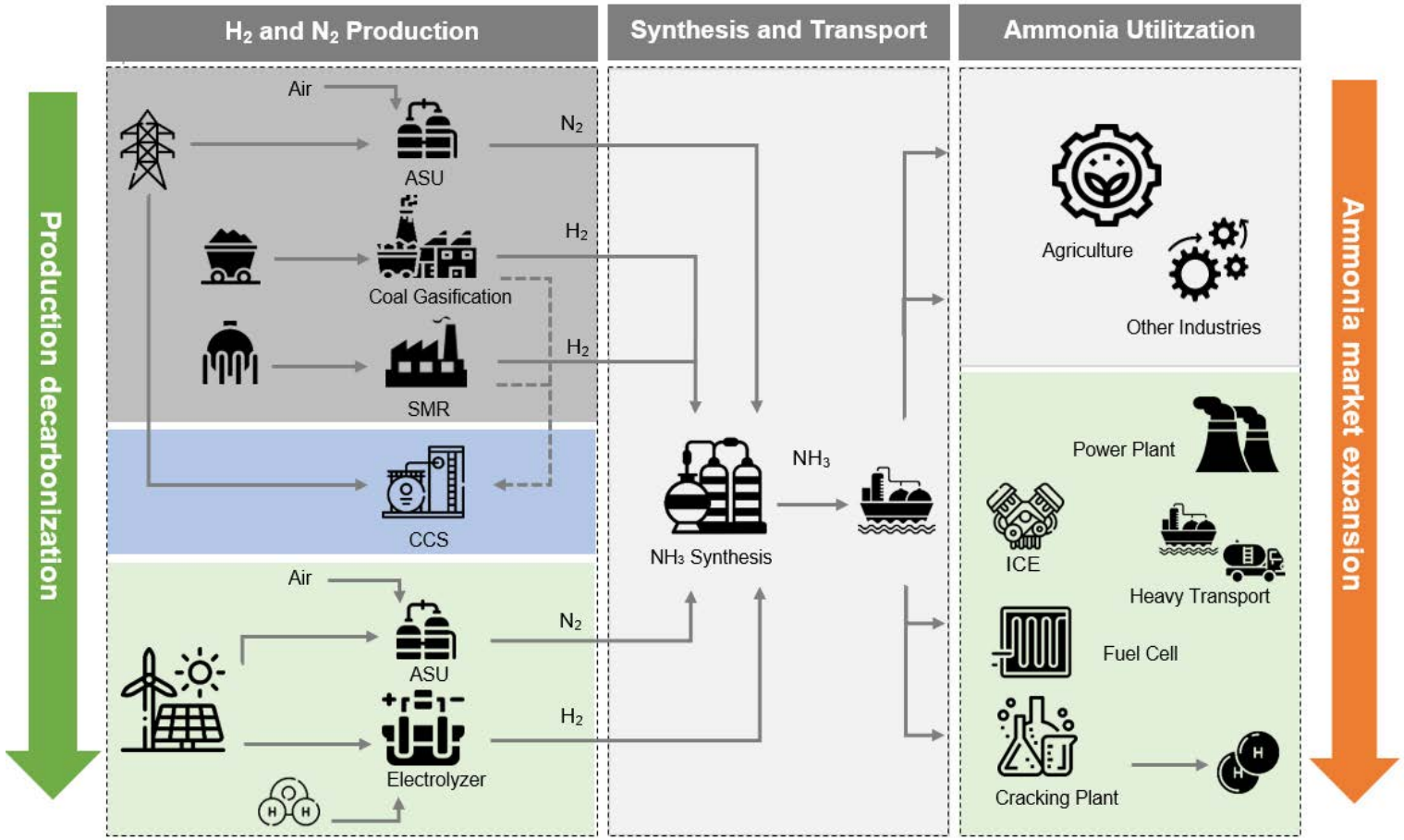


- 20.6 Mt (12 %) of global production is traded between countries.
- Today, large exporters are gas producing countries.
- The main exporters of ammonia derivates are Trinidad&Tobago and Russia.
- The largest net importer is the U.S. followed by the EU
- Ammonia terminals already exist in 200 harbors worldwide.

GREEN, BLUE AND CONVENTIONAL AMMONIA

Egerer, J., V. Grimm, K. Niazmand und P. Runge (2023a), **The economics of global green ammonia trade – "Shipping Australian wind and sunshine to Germany"** Applied Energy, 334 (2023), 120661

Blue ammonia is available faster, which allows a scaleup of infrastructure and applications



SMR- steam methane reforming, ATR- auto-thermal reforming, CCS- carbon capture and storage, ASU- Air separation unit, ICE- Internal combustion engines; Blue ammonia can be produced through SMR and CCS or alternatively via ATR with CCS, *Images: Flaticon.com*

Upstream transition :

- Sustainable processes for feedstock production, i.e., electrolyzers for H_2 to replace coal gasification and steam methane reforming (SMR)
- Air separation unit for nitrogen (N_2) and ammonia synthesis.
- Direct integration in existing transport infrastructure is possible.

Downstream transition :

- Today, more than two thirds of the ammonia production is used for mineral nitrogen fertilizers.
- Transition could allow ammonia to gain a foothold in several new sectors

INDUSTRIAL VALUE CHAINS WILL RELOCATE

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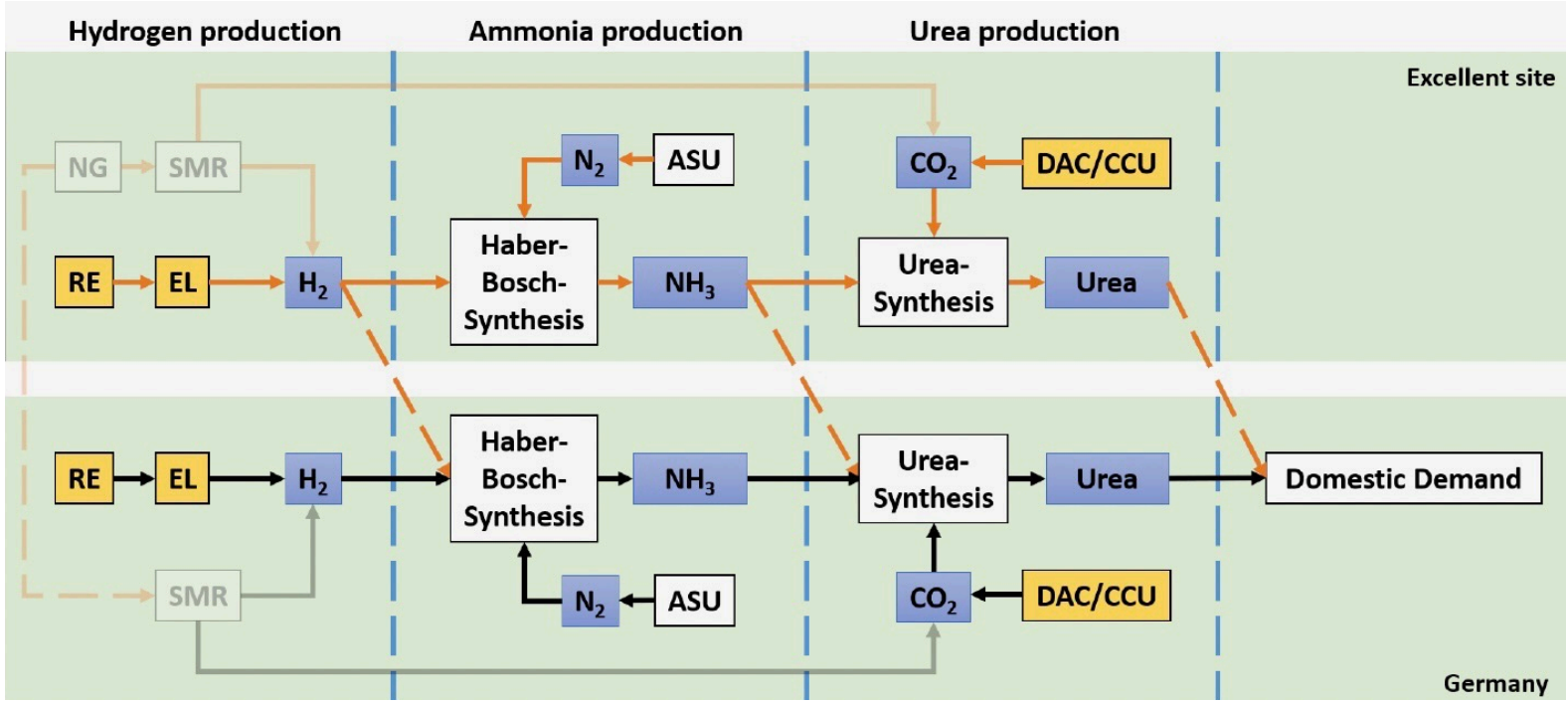

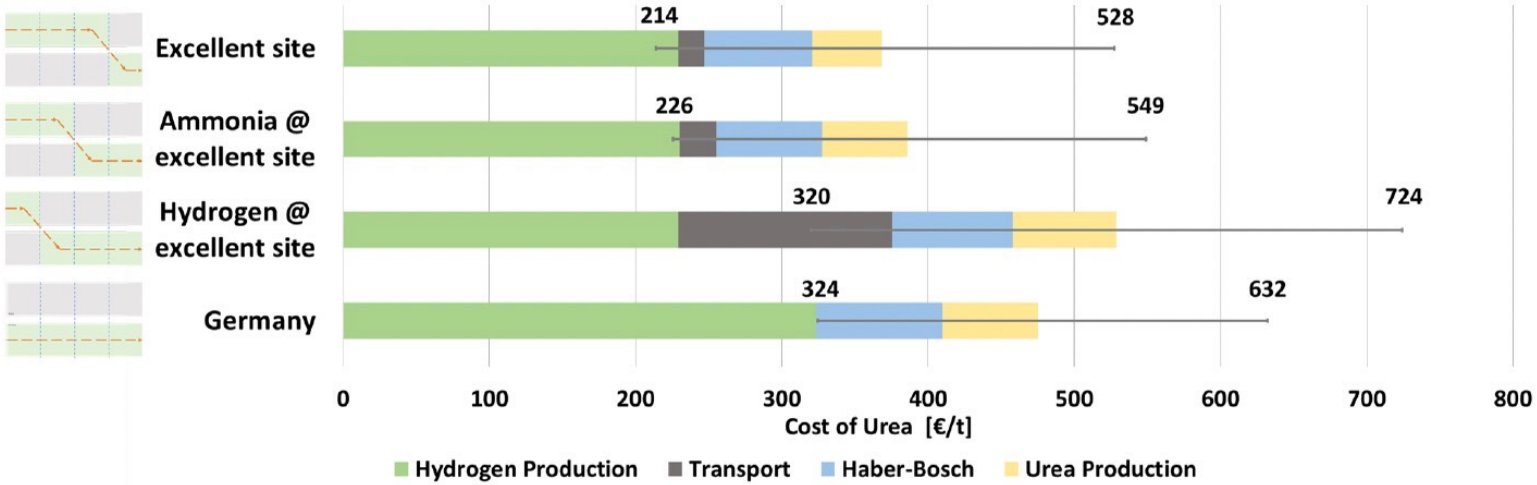

- Addition/removal of individual process steps and energy sources
- Development of new infrastructures with regard to CO2 and H2
- Expanded global trade in intermediate products (e.g. olefins, MeOH, carbon)

Egerer, J., V. Grimm, N. Farhang-Damghani und P. Runge (2023b), **The Industry Transformation from Fossil Fuels to Hydrogen will reorganize Value Chains: Big Picture and Case Studies for Germany,**

GEOPOLITICAL CHALLENGES HAVE TO BE ADDRESSED UNDERWAY

RETHINK INTERDEPENDENCIES

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	Dependence on ...	Share of products with strong import dependency in total imports	Number of products with strong import dependency	Trade value of products with strong import dependency
		%		1,000 US dollars
1	 China	45.1	208	19,003,594.60
2	 United States	15.7	197	6,640,676.25
3	 Switzerland	4.4	204	1,875,778.63
4	 Netherlands	4.4	219	1,867,587.10
5	 United Kingdom	3.2	222	1,331,753.42
6	 South Africa	2.6	73	1,110,997.78

CRITICAL RAW MATERIALS

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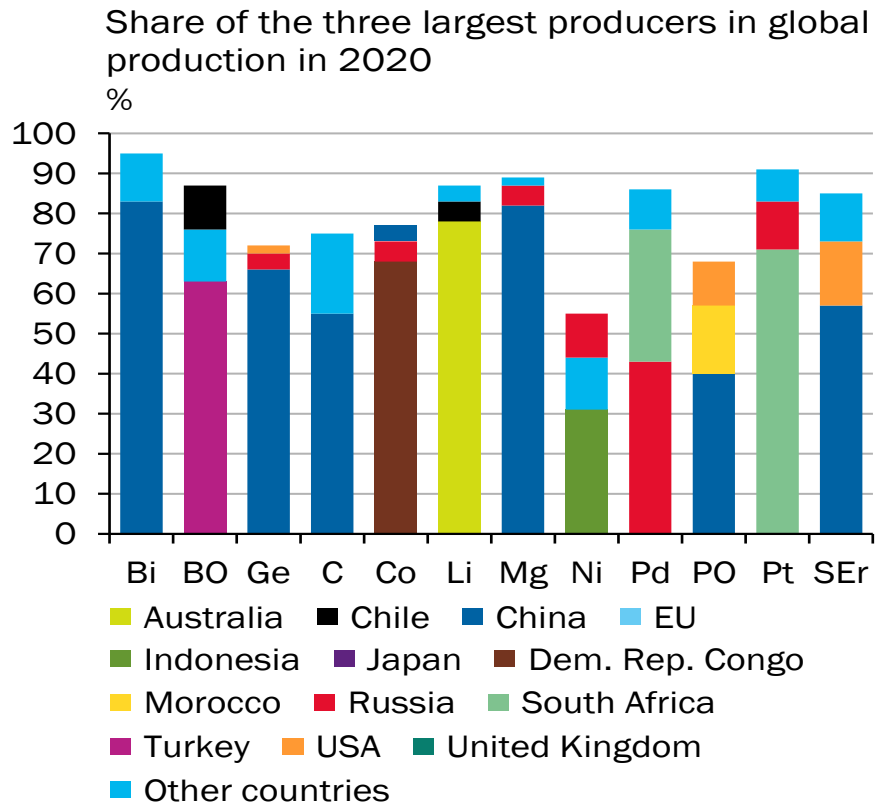
Advance diversifcation and increase European production capacities

Extraction of critical resources/minerals is very concentrated



Source: U.S. Geological Survey (2021)
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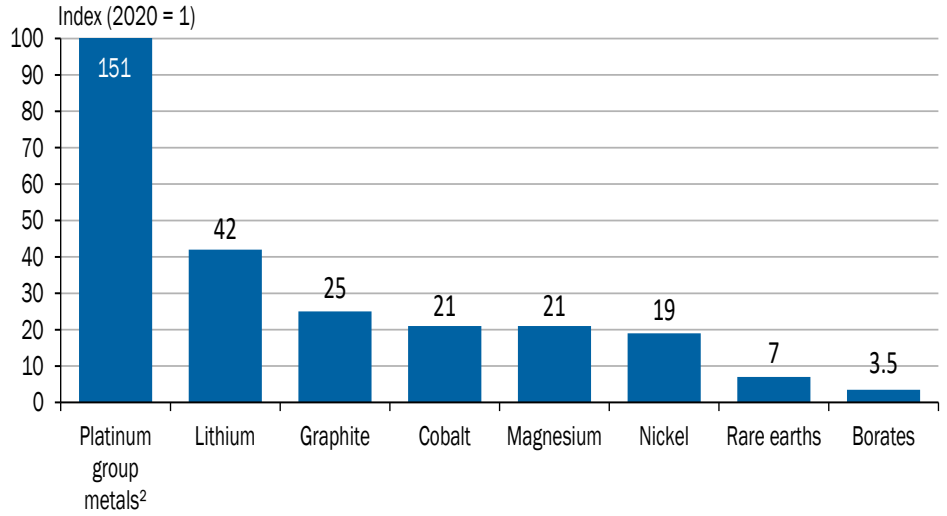
Growth of global demand for selected critical raw materials over the period 2020 to 2040[1]



1 – Projections based on the International Energy Agency (IEA) Sustainable Development Scenario, which indicates total demand in a scenario consistent with the Paris Agreement targets. 2 – Includes iridium, osmium, palladium, platinum, rhodium and ruthenium.

Source: IEA (2021)
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MARKET DISTORTIONS THROUGH SUBSIDIES

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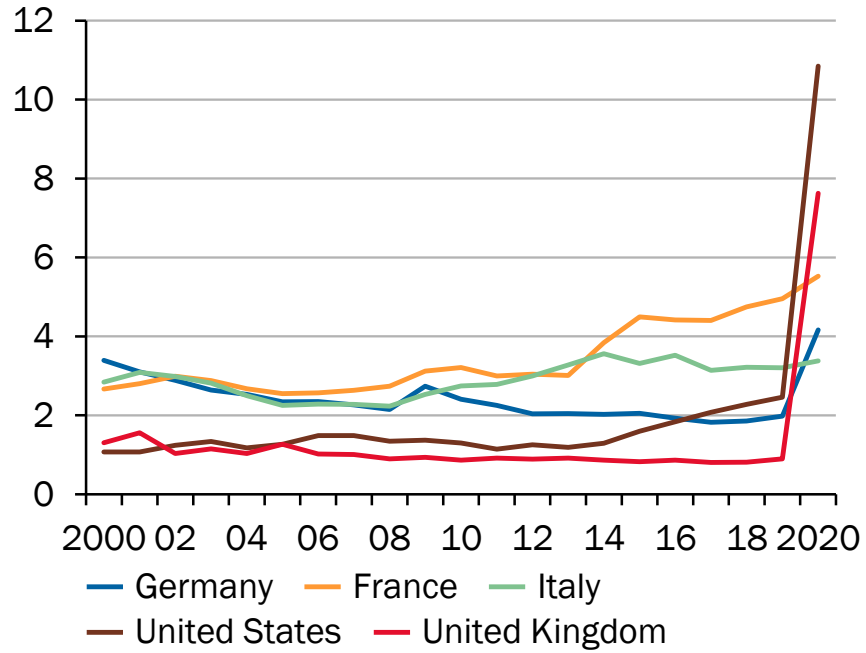
Competition can be distorted by subsidies from third countries, but systematic assessment of the subsidies is hardly possible

Heterogeneous subsidy concept

Total general government subsidies according to national accounts definition

% of government expenditure

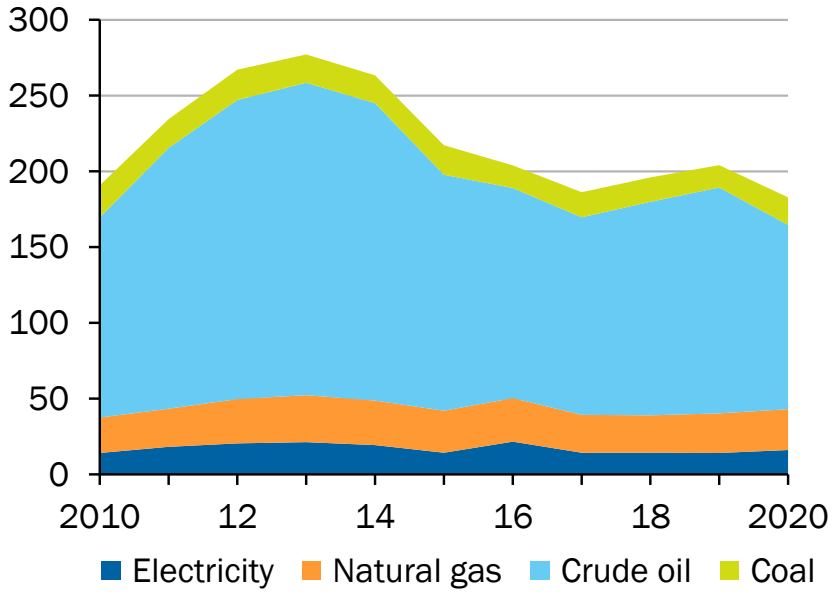


Sources: OECD, own calculations

Slow decline in subsidies for fosssil fuels

Global subsidies over time

US dollars billion



Source: OECD

INFLATION REDUCTION ACT

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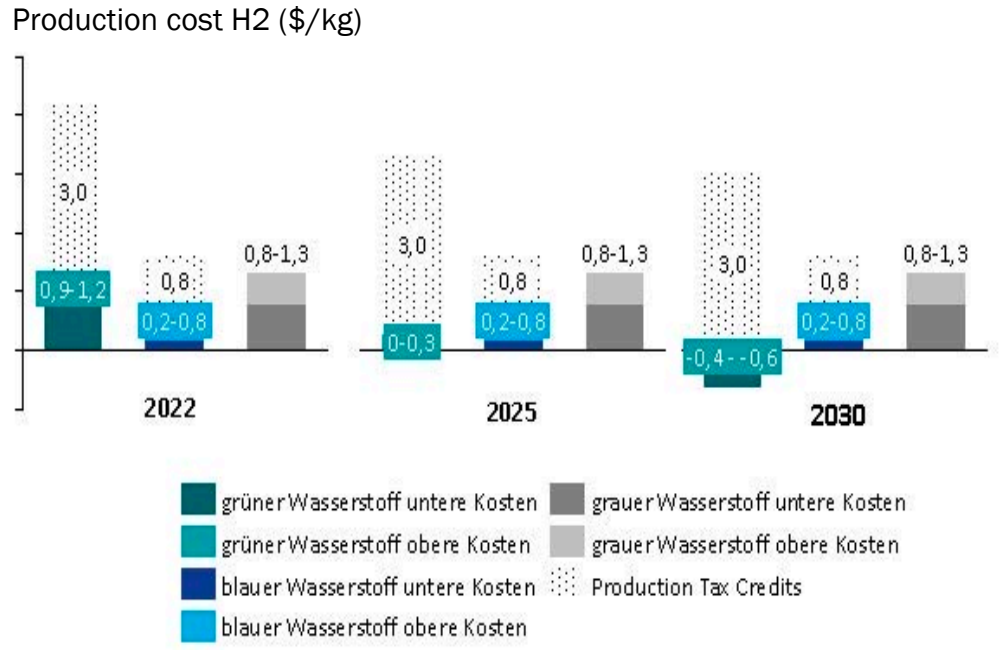
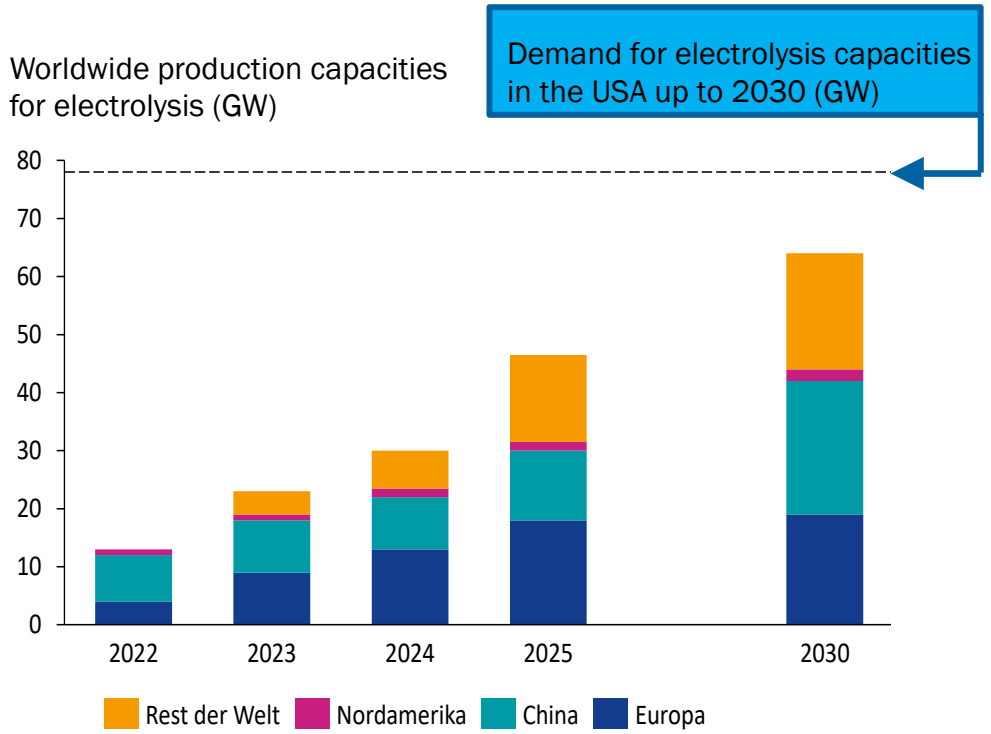
Tax credits for renewables and hydrogen should massively accelerate the scaling of a hydrogen economy

Evolution of hydrogen cost of goods sold through the Inflation Reduction Act



Quellen: BCG, NWR

Development of global production capacities for electrolysis, source: IEA, NWR calculations



Quellen: BCG, NWR

Source: National H2 Council at https://www.wasserstoffrat.de/fileadmin/wasserstoffrat/media/Dokumente/2022/2022-12-09_NWR-Stellungnahme_Inflation-Reduction-Act.pdf

GLOBAL PUBLIC GOODS BECOME EVER MORE IMPORTANT

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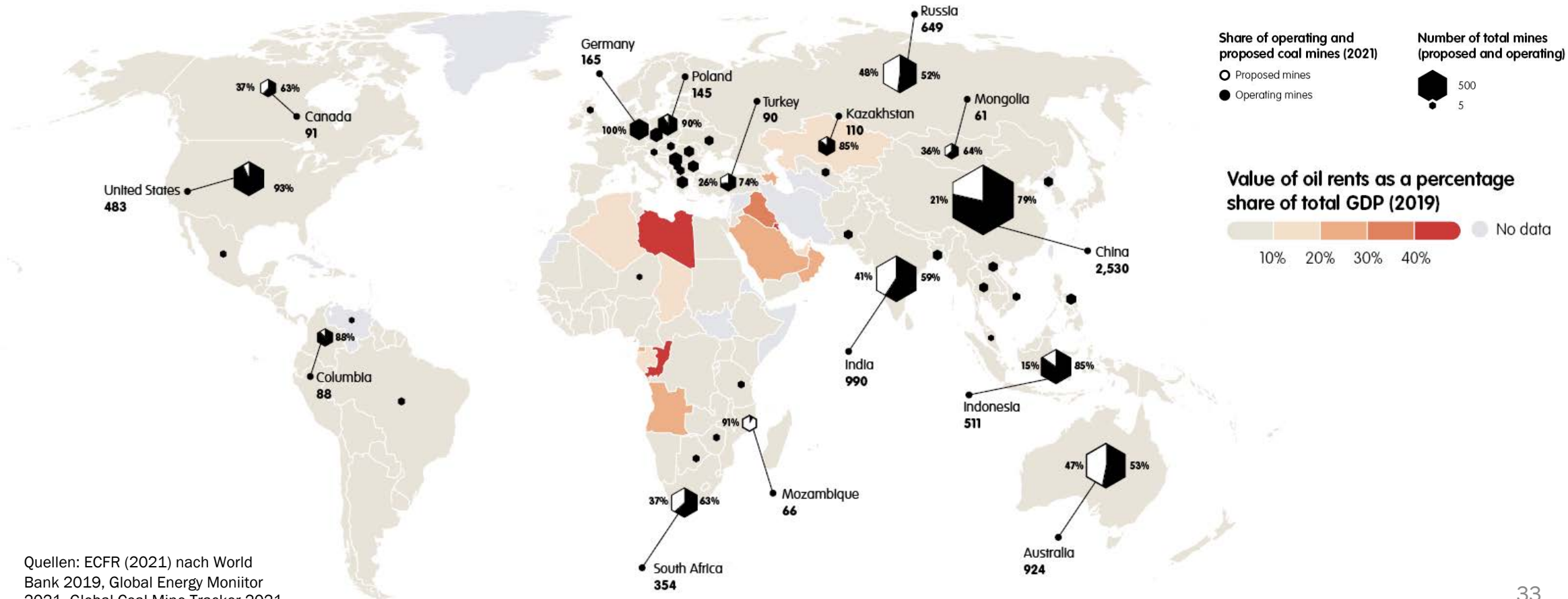
Whether it's climate protection, health or peace - global cooperation will be crucial - even with "unfriendly" states

Oil rents and number of coal mines by country



Quellen: ECFR (2021) nach World Bank 2019, Global Energy Moniitor 2021, Global Coal Mine Tracker 2021

CHANGES OF THE GLOBAL ORDER

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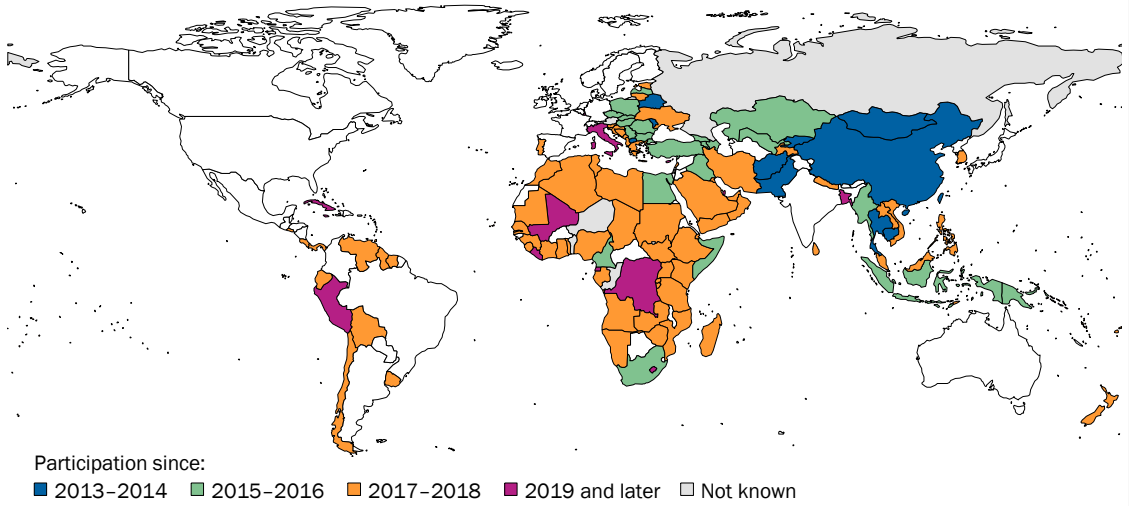
Gradual dissolution of the rule-based order, Europe's strategic autonomy must be strengthened

138 countries participate in the „New Silk Road“



Sources: Council on Foreign Relations, EuroGeographics regarding administrative boundaries
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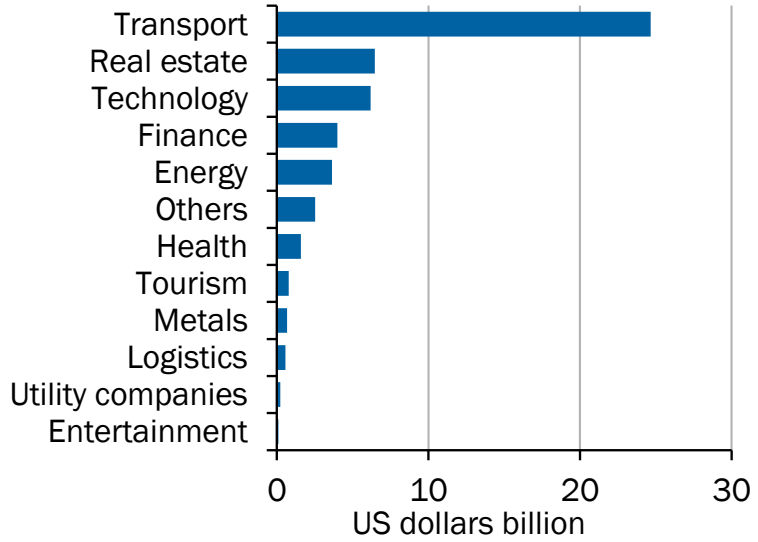
China's direct investments in Germany between 2005 and 2021

Level of Chinese direct investment by industry[2]



Sources: Deutscher Bundestag, Eurostat
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DIVERSIFICATION & GLOBAL PUBLIC GOODS

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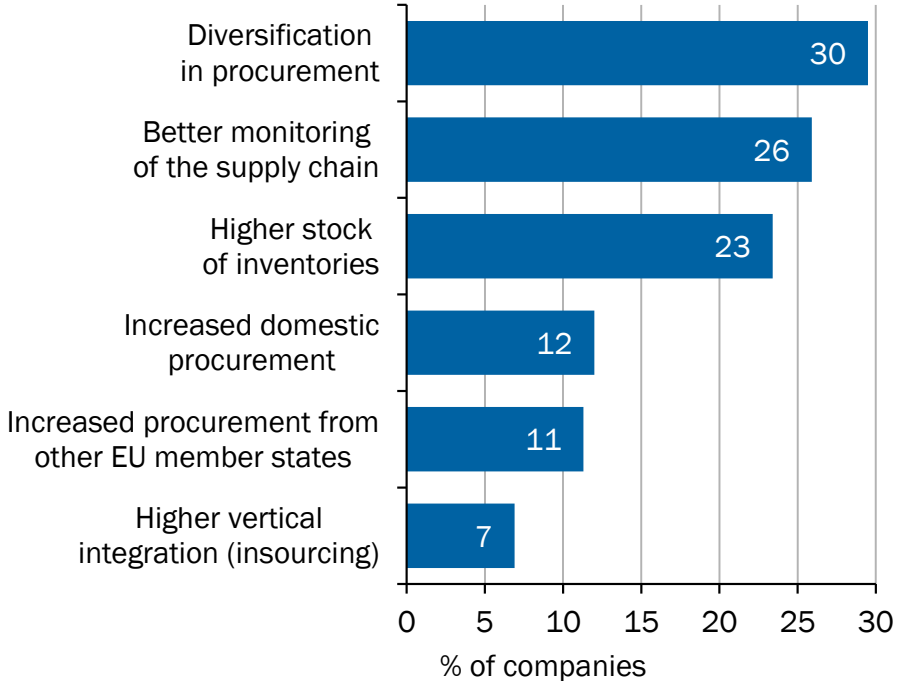
Interdependence can be „weaponized“ –but is also needed to address global challenges

Diversification of supply chains is mainly the companies‘ responsibility ; the government can help through directed support

Companies are adapting their procurement strategies
Manufacturing



Sources: Flach et al. (2021), ifo Business Survey, May 2021
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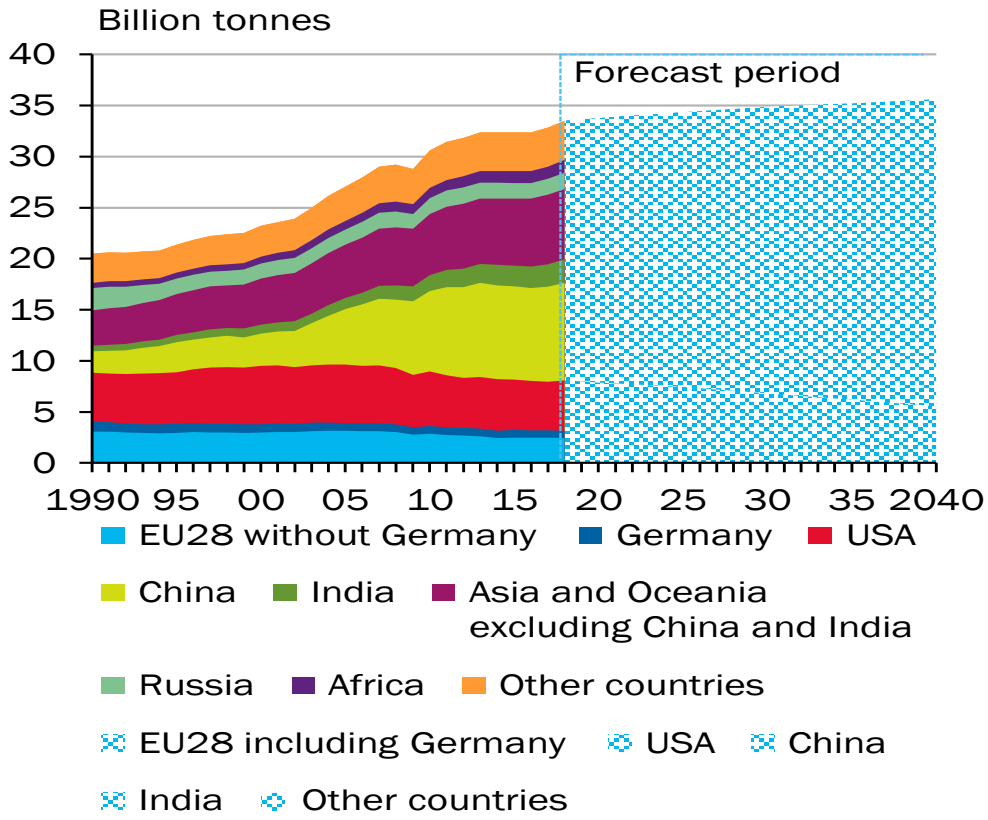
Increasing role of global public goods

CO_2 emissions by country



OPEN STRATEGIC AUTONOMY

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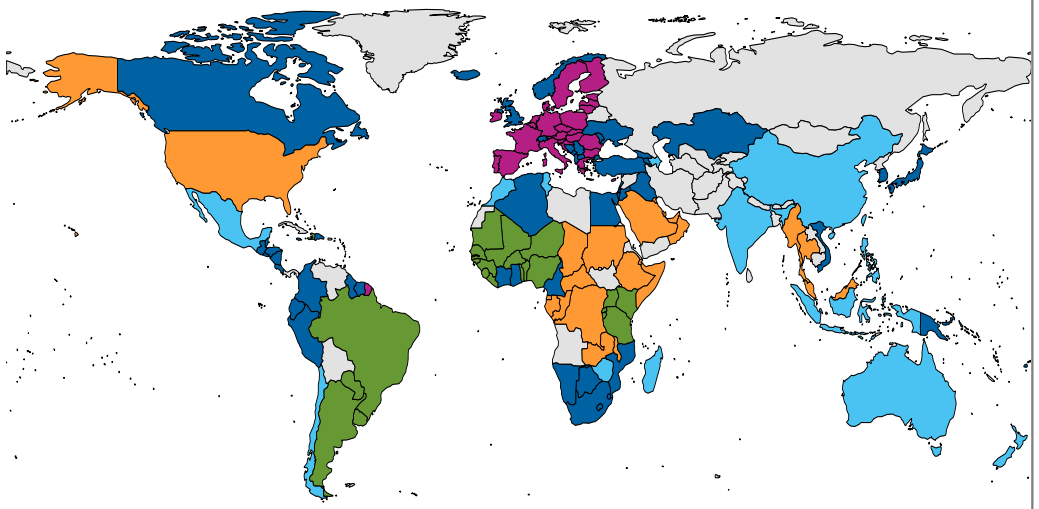
An attractive global environment for “Clean Tech“ investments is of key importance

Apply countervailing measures against trade distortions and advance new (free) trade agreements



Sources: EuroGeographics for the administrative boundaries, European Commission
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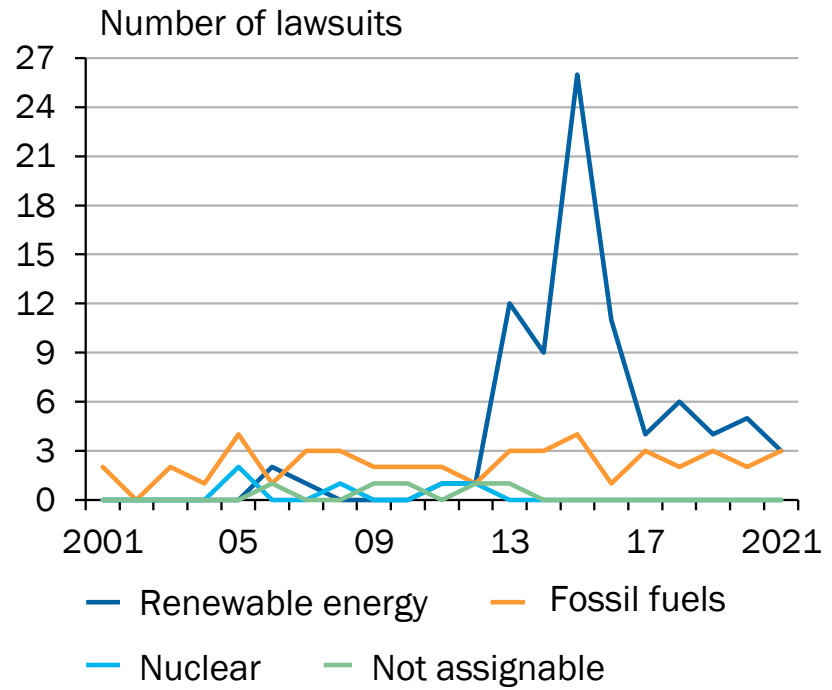
Lawsuits within the Energy Charta Treaty by energy source



Quelle: Energy Charter Secretariat
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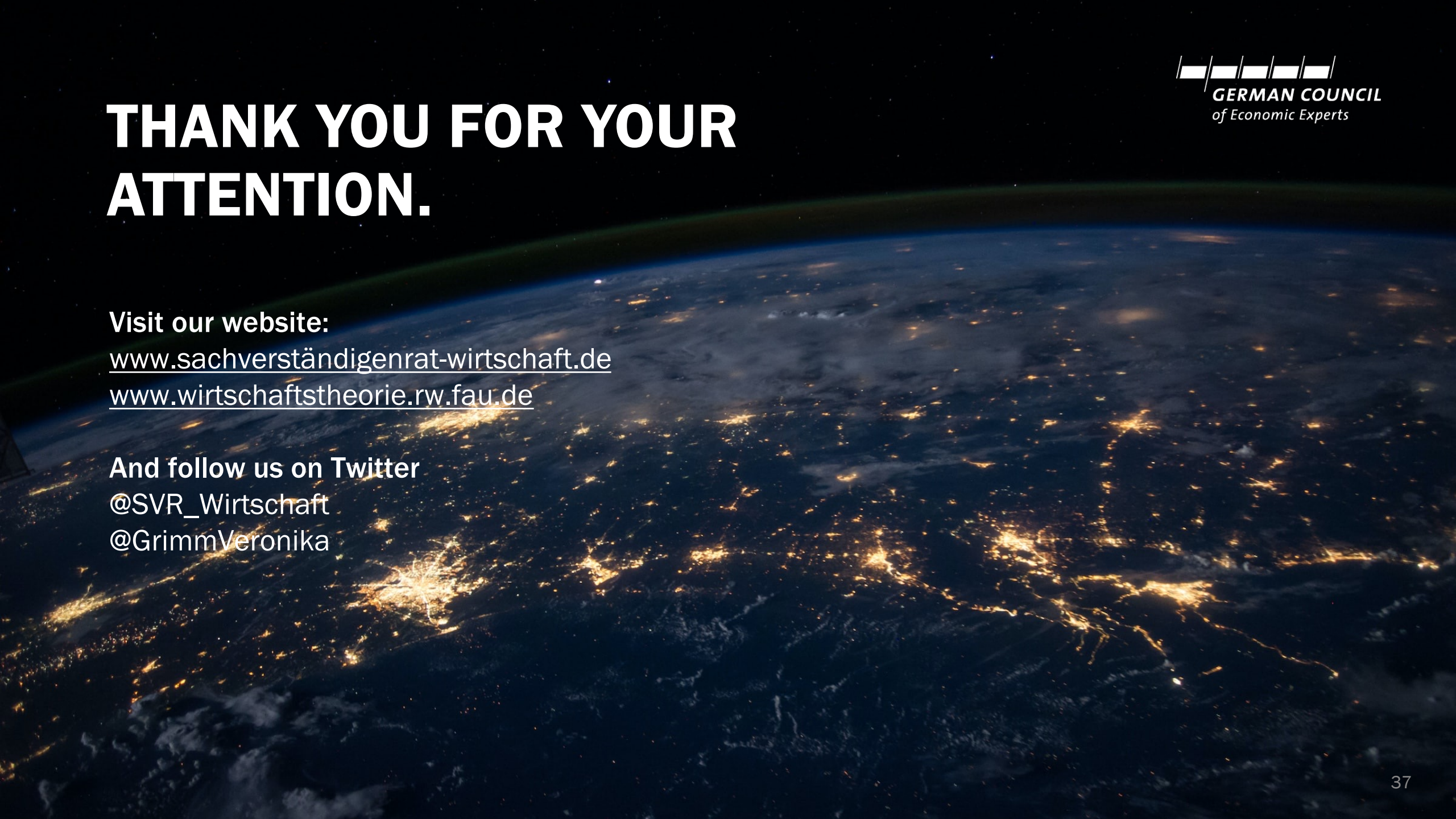

THANK YOU FOR YOUR ATTENTION.

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